US008418283B2

(12) **United States Patent**
Serhan et al.

(10) **Patent No.: US 8,418,283 B2**
(45) **Date of Patent: Apr. 16, 2013**

(54) **UNIVERSAL BED SYSTEM**

(75) Inventors: **Michael Serhan**, Acadia, CA (US); **Harvey Diamond**, Armonk, NY (US)

(73) Assignee: **Drive Medical Design & Mfg.**, Port Washington, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 7 days.

(21) Appl. No.: **13/103,573**

(22) Filed: **May 9, 2011**

(65) **Prior Publication Data**

US 2011/0271443 A1 Nov. 10, 2011

Related U.S. Application Data

(60) Provisional application No. 61/333,096, filed on May 10, 2010.

(51) **Int. Cl.**
A47C 31/00 (2006.01)

(52) **U.S. Cl.**
USPC **5/11**; 5/610; 5/611

(58) **Field of Classification Search** 5/11, 611, 5/610, 600, 183; 108/20, 147
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,522,759	A *	9/1950	Lindquist	5/610
3,015,113	A *	1/1962	Wallen	5/11
3,045,256	A *	7/1962	Scher	5/11
3,105,246	A	10/1963	Emrick	
3,919,727	A	11/1975	Paine	
4,324,010	A	4/1982	Houlberg et al.	
4,846,011	A	7/1989	Gaffney	
5,134,731	A	8/1992	Quintile et al.	
5,544,375	A	8/1996	Urness et al.	
5,685,035	A	11/1997	Urness et al.	
5,713,091	A	2/1998	Houchin	
5,802,639	A	9/1998	Raasch et al.	
5,964,347	A	10/1999	Urness	
6,000,077	A	12/1999	Cyr	
6,678,907	B1	1/2004	Voelker et al.	
6,779,210	B1	8/2004	Kelly	
6,983,495	B2 *	1/2006	Snyder et al.	5/11
6,997,082	B2 *	2/2006	Snyder et al.	74/606 R
7,302,716	B2	12/2007	Snyder et al.	
7,441,289	B2 *	10/2008	Loewenthal	5/611
2006/0053550	A1 *	3/2006	Snyder et al.	5/11
2007/0080030	A1	4/2007	Kramer	
2009/0094747	A1	4/2009	Bly et al.	
2009/0100598	A1	4/2009	Bly et al.	

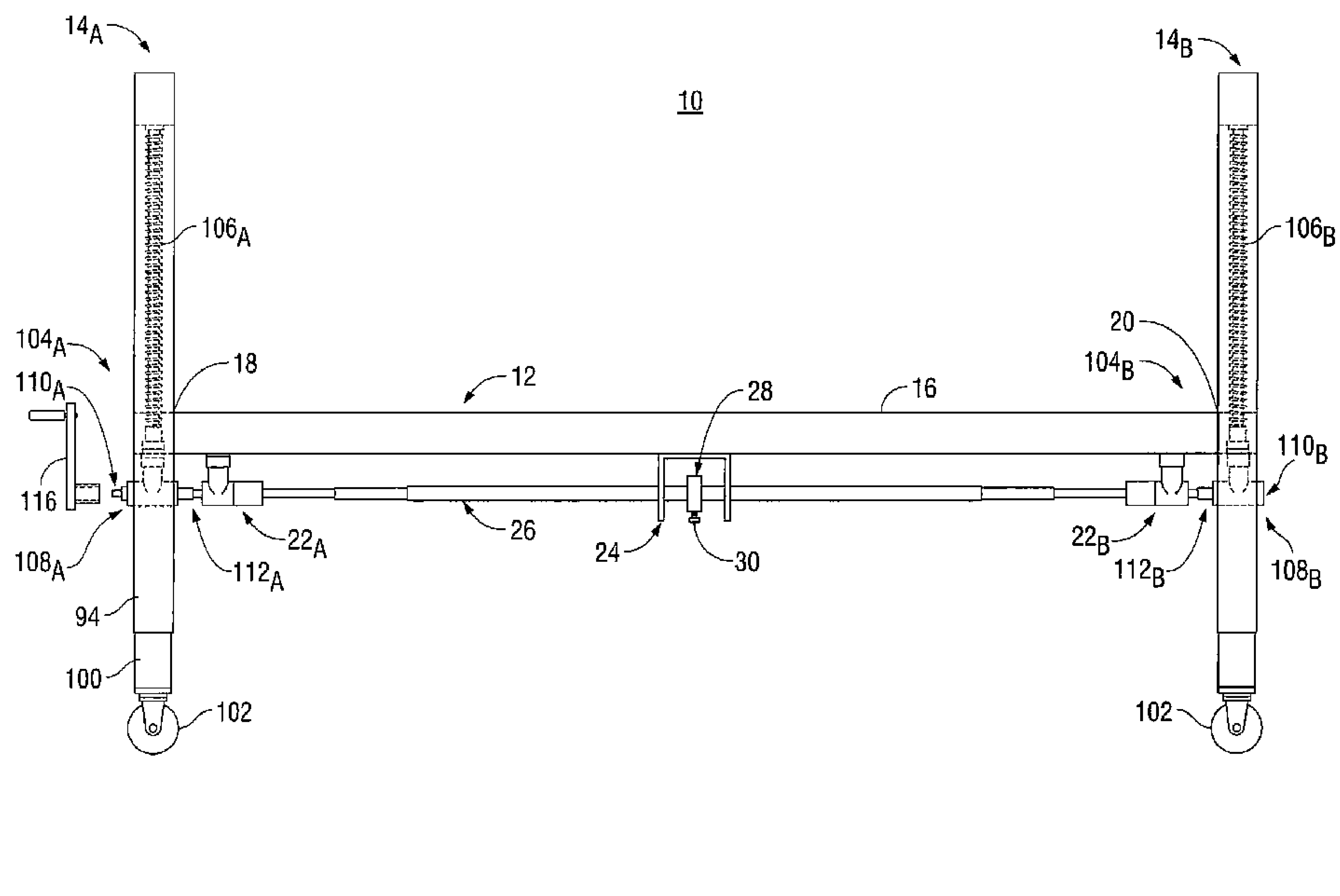
* cited by examiner

Primary Examiner — Robert G Santos
Assistant Examiner — Richard G Davis
(74) *Attorney, Agent, or Firm* — Carter, DeLuca, Farrell & Schmidt, LLP

(57) **ABSTRACT**

The present disclosure relates to an adjustable bed system including a bed frame that is adjustable in height. In one aspect of the present disclosure, the adjustable bed system includes first and second end boards each having an independent height adjustment mechanism. A frame assembly configured and dimensioned to be secured to the first end board at a first end thereof and to the second end board at a second end thereof includes a frame and a transition box. The transition box is secured to the frame at the first end thereof and is operatively engagable with the height adjustment mechanism of the first end board. A drive shaft adjustable between first and second lengths is coupled at a first end thereof to the transition box and at a second end thereof to the second end board to facilitate uniform height adjustment of the first and second end boards.

18 Claims, 17 Drawing Sheets



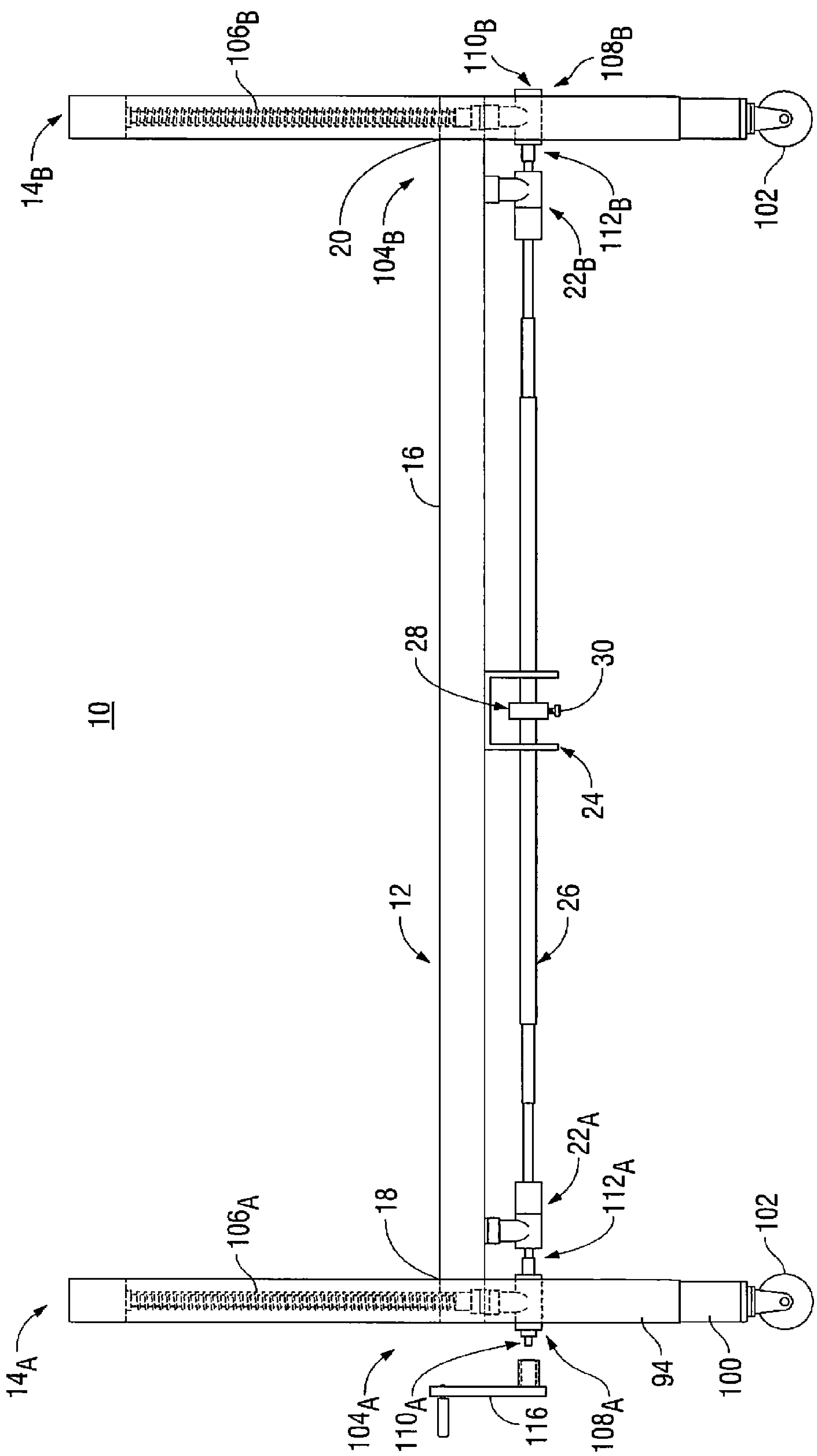

10
12
14A
14B
16
18
20
22A
22B
24
26
28
30
94
100
102
102
104A
104B
106A
106B
108A
108B
110A
110B
112A
112B
116

FIG. 1

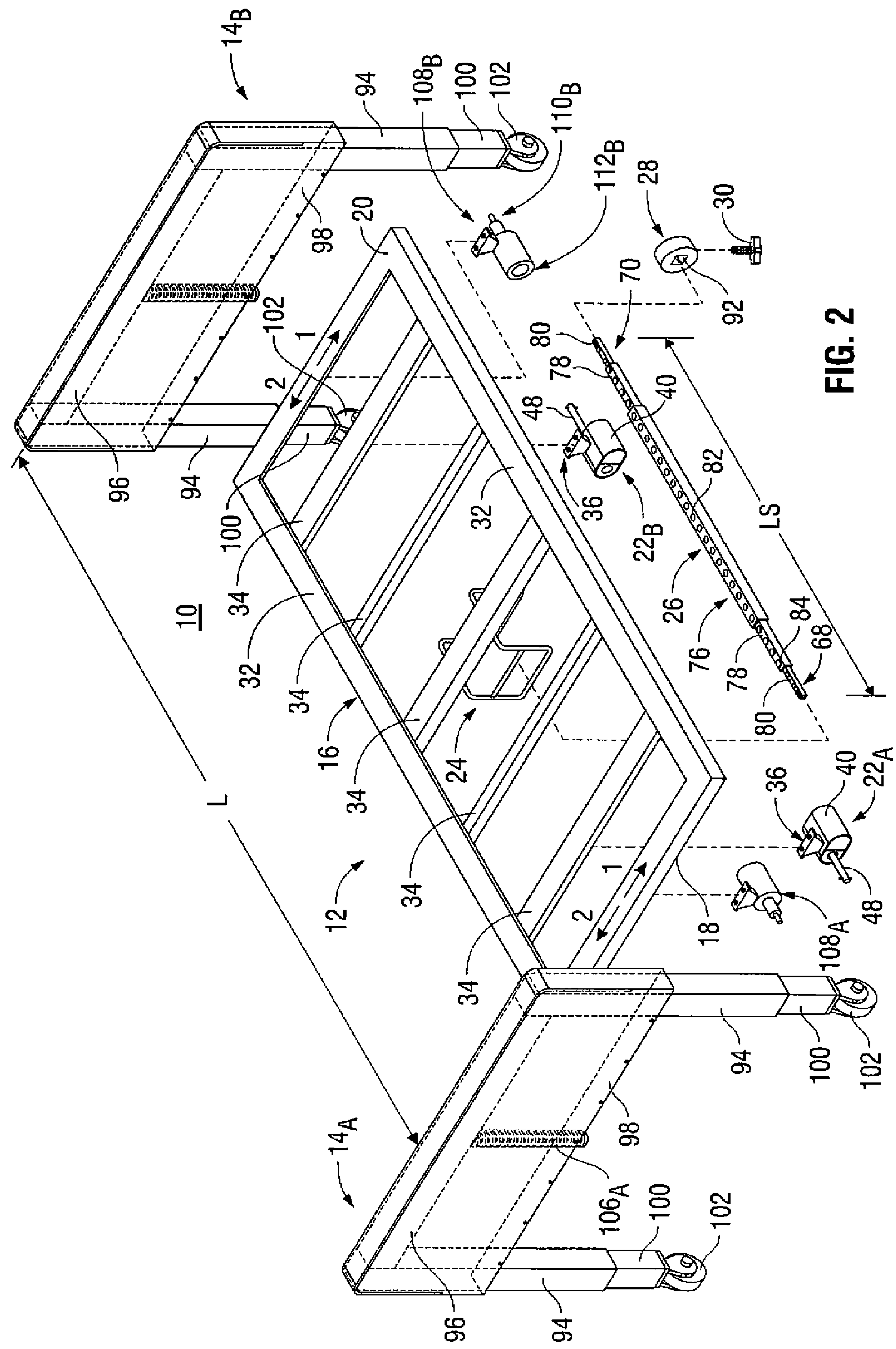

10
12
14A
14B
16
18
20
22A
22B
24
26
28
30
32
34
36
40
48
68
70
76
78
80
82
84
92
94
96
98
100
102
106A
108A
108B
110B
112B
L
LS
1
2

FIG. 2

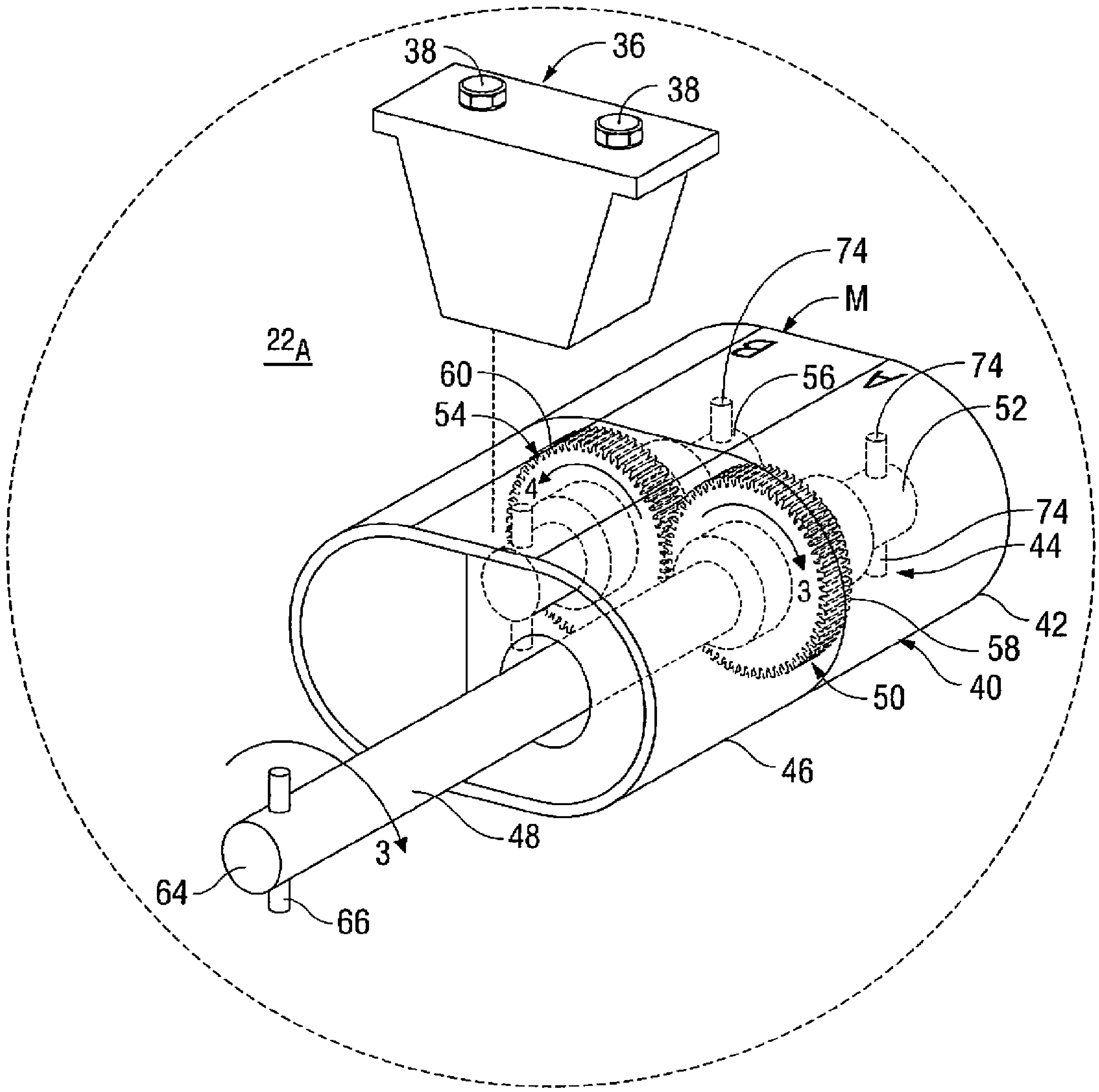


FIG. 3

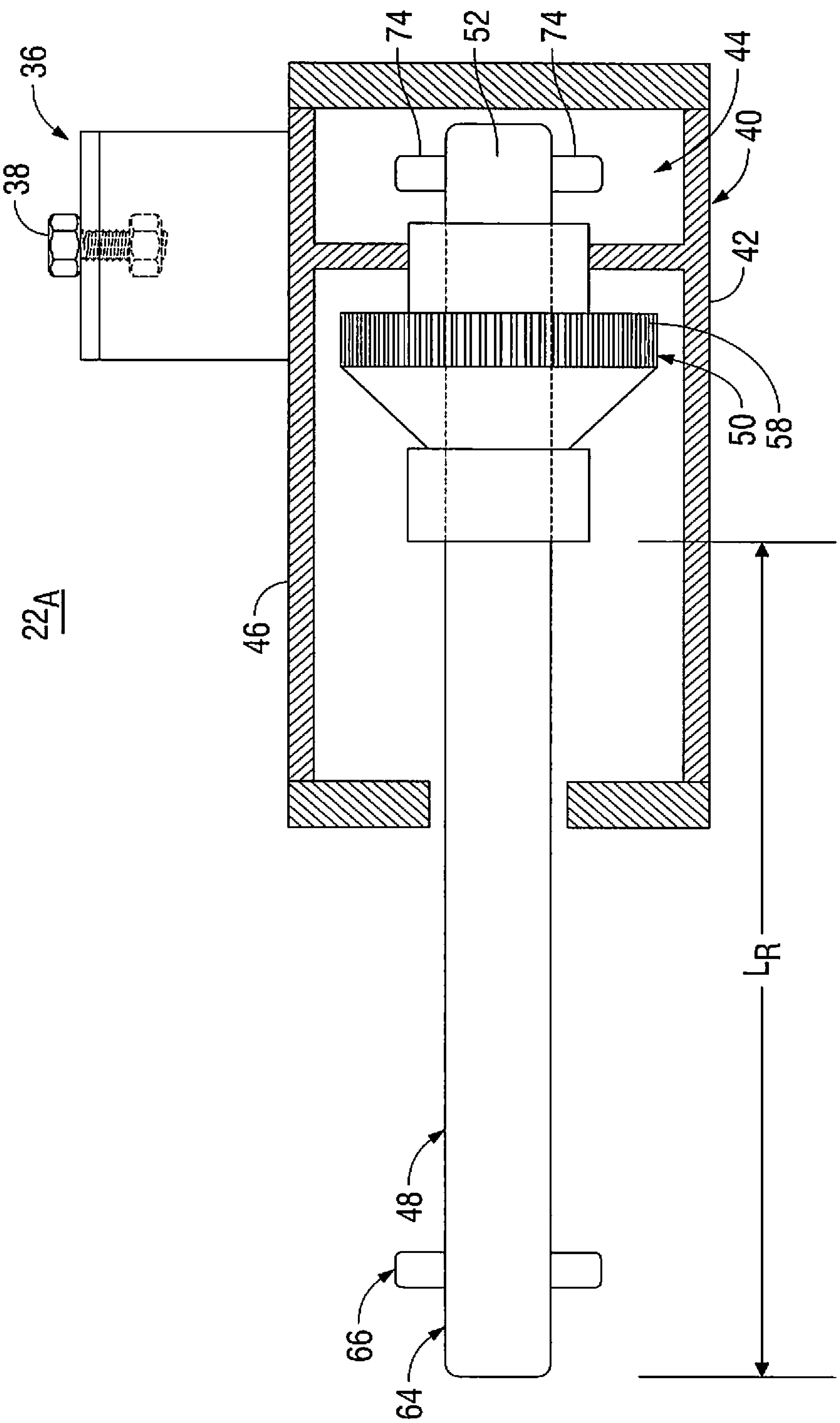


FIG. 4

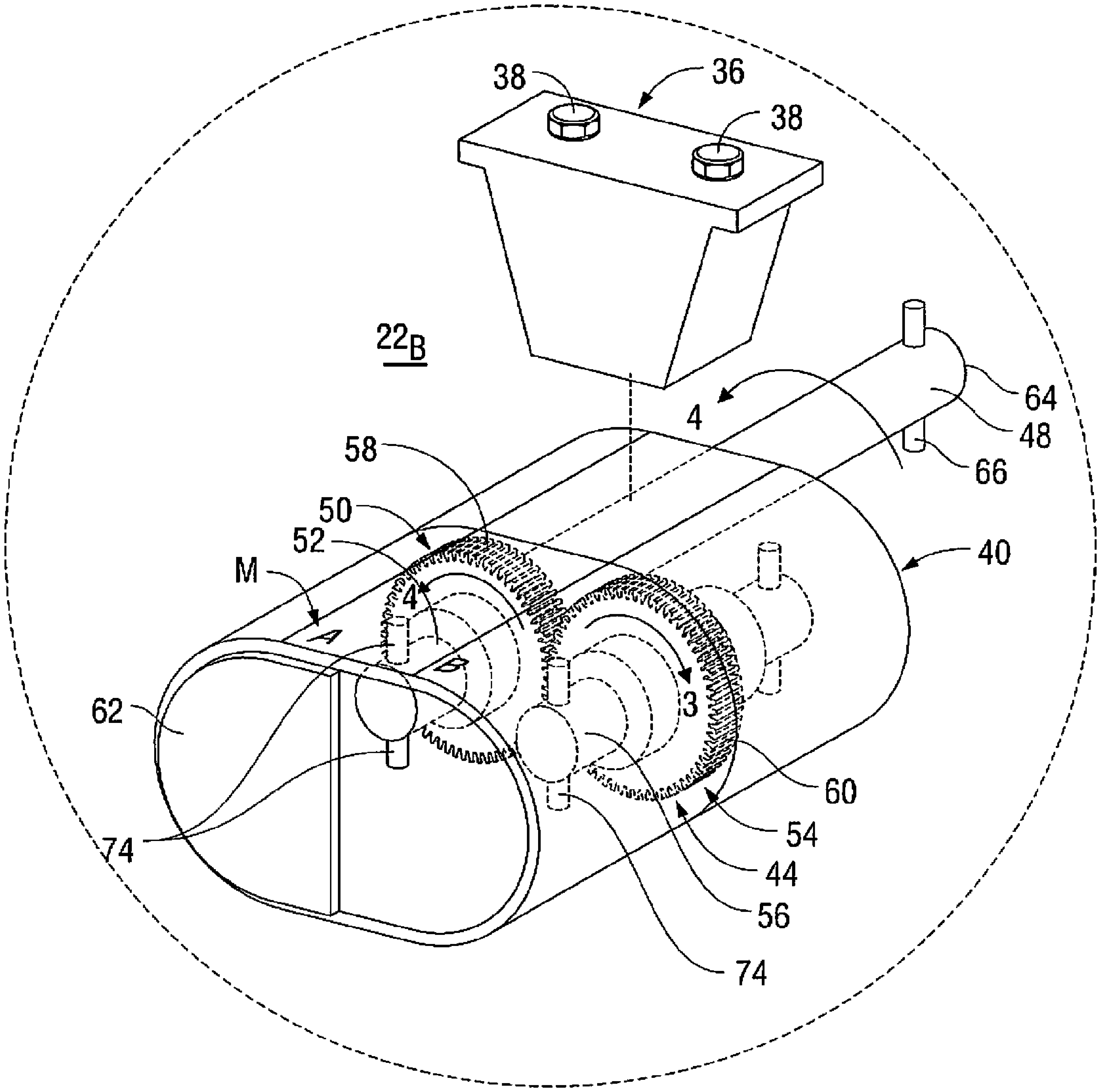


FIG. 5

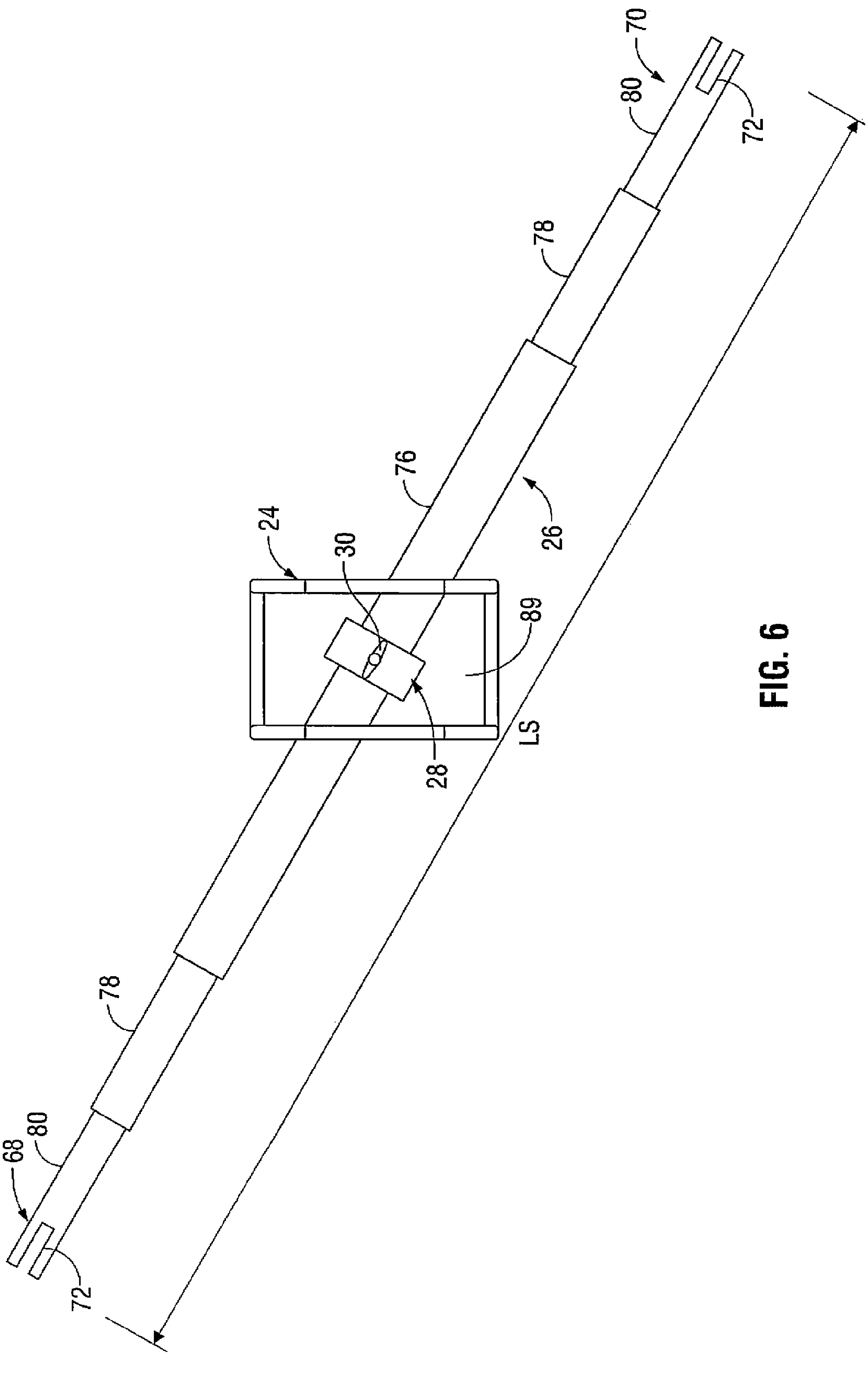


FIG. 6

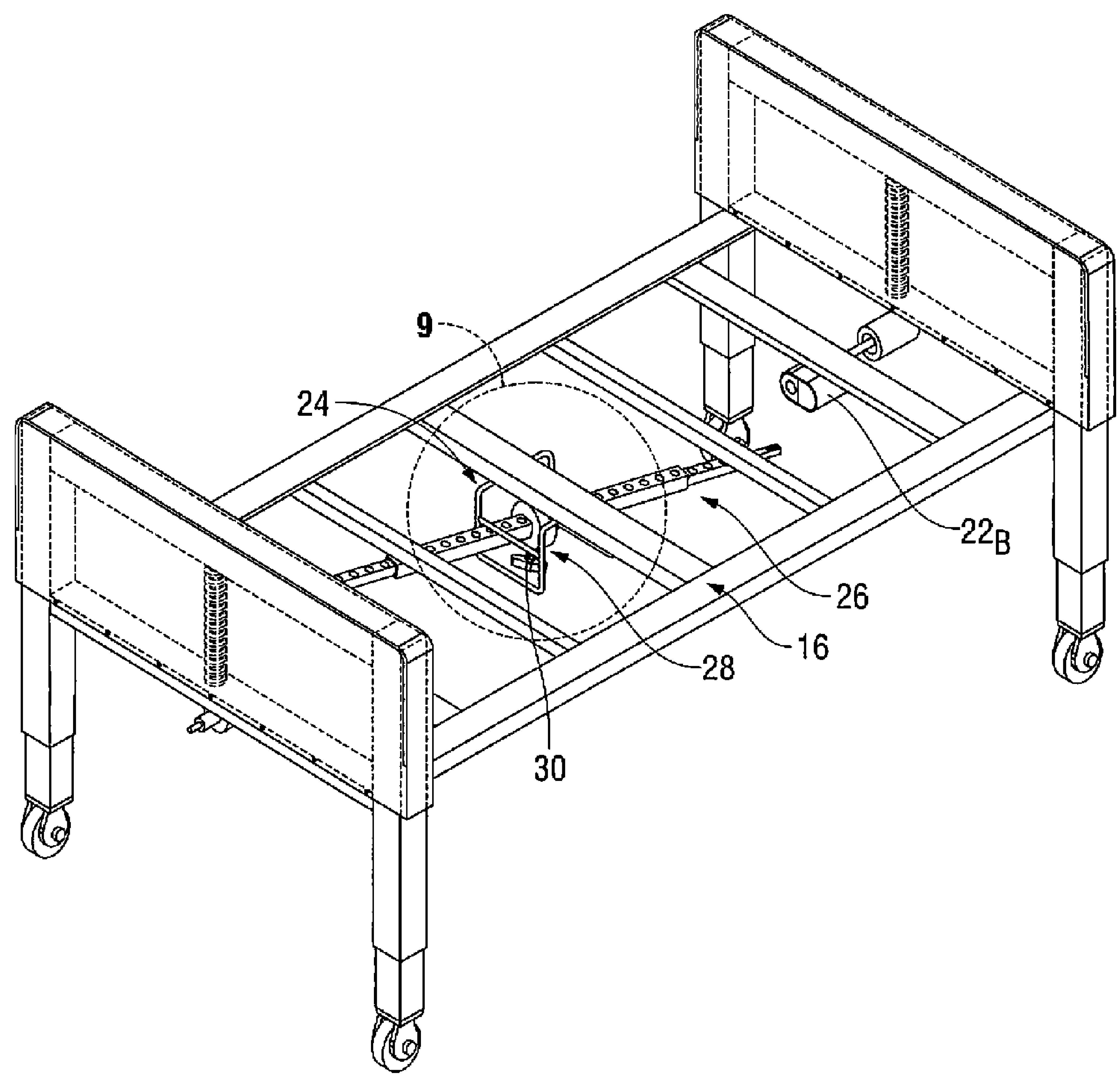


FIG. 7

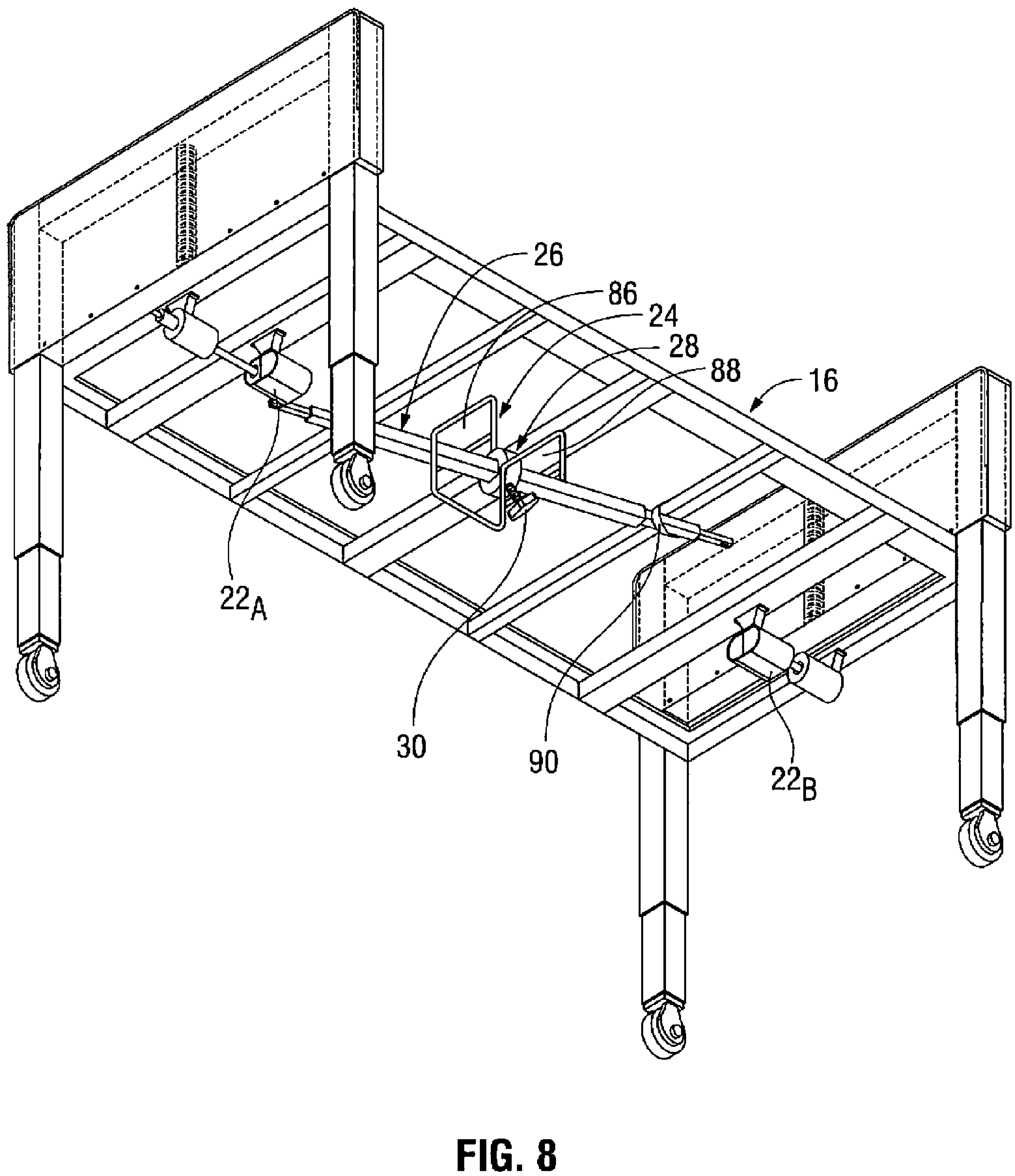


FIG. 8

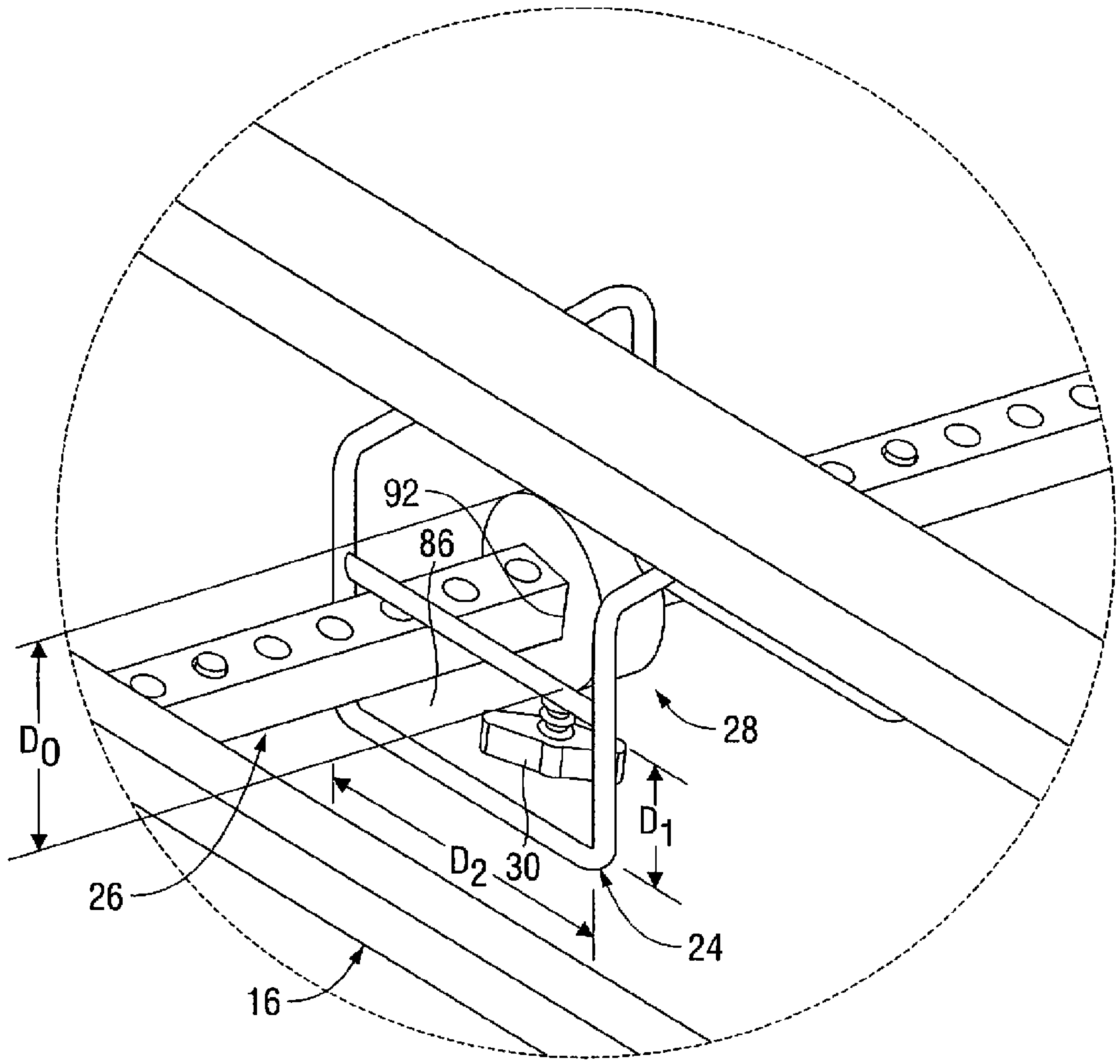


FIG. 9

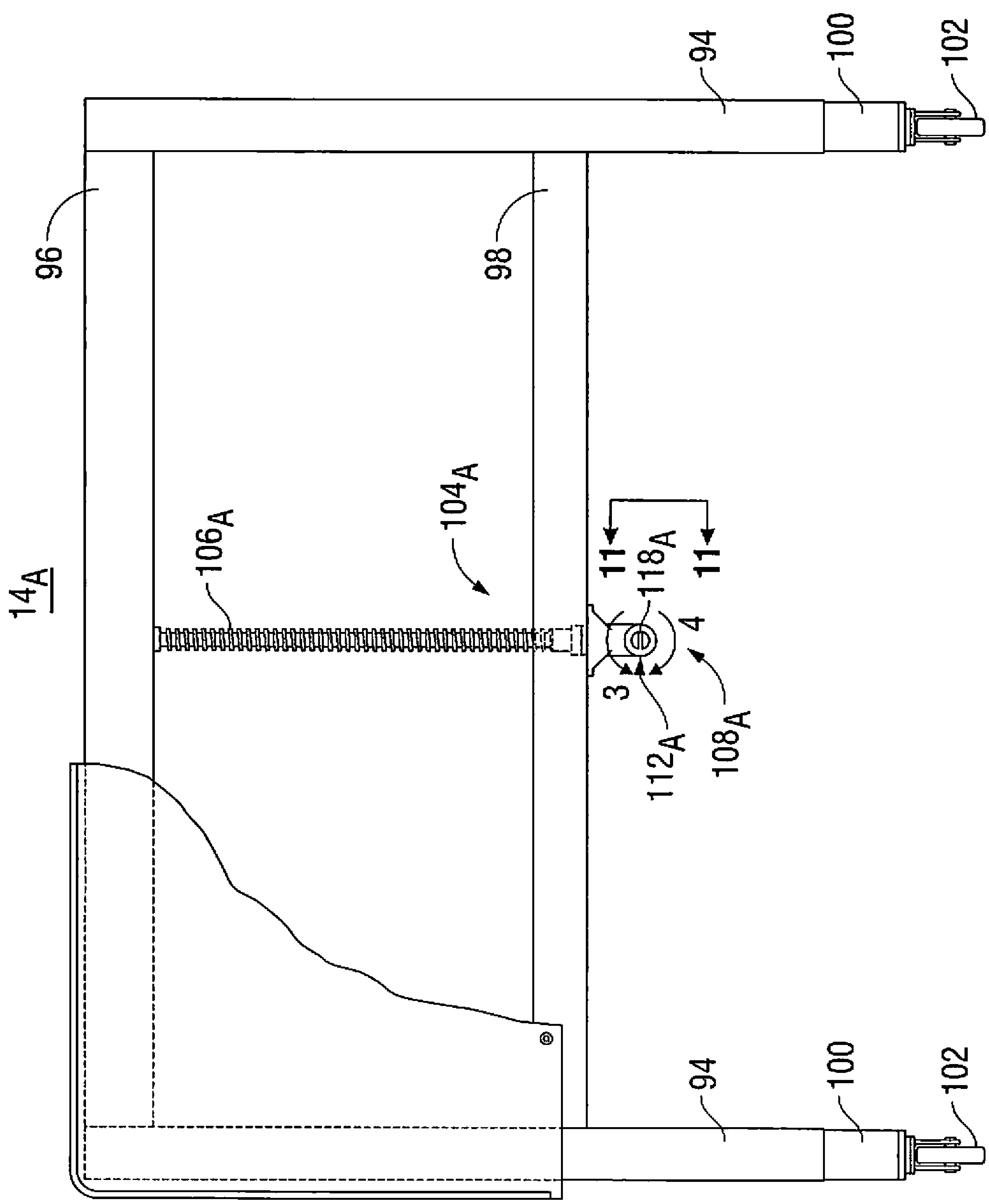


FIG. 10

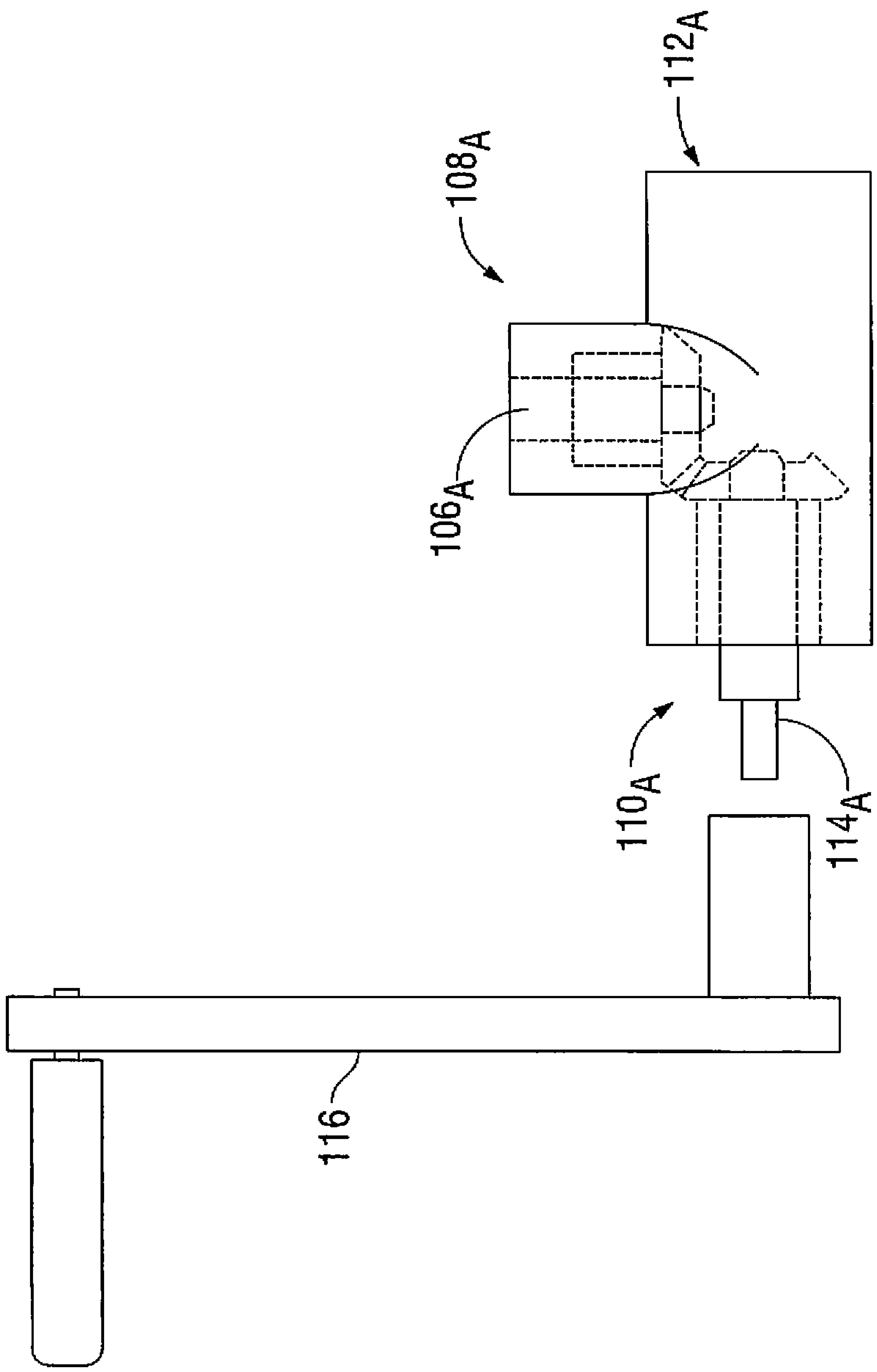


FIG. 11

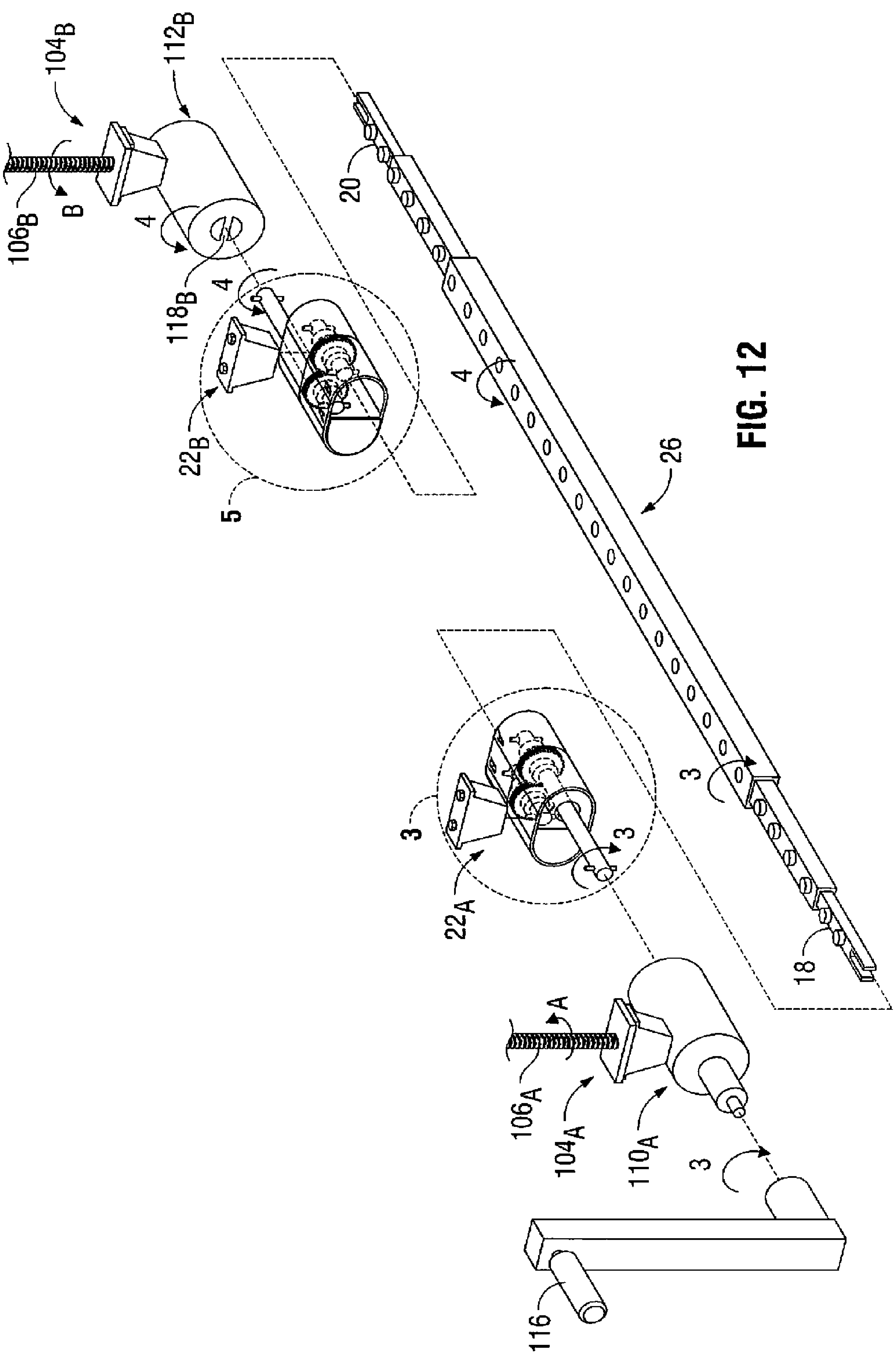

104B
112B
106B
B
4
118B
4
22B
5
20
4
26
3
3
3
22A
18
A
106A
104A
110A
3
116

FIG. 12

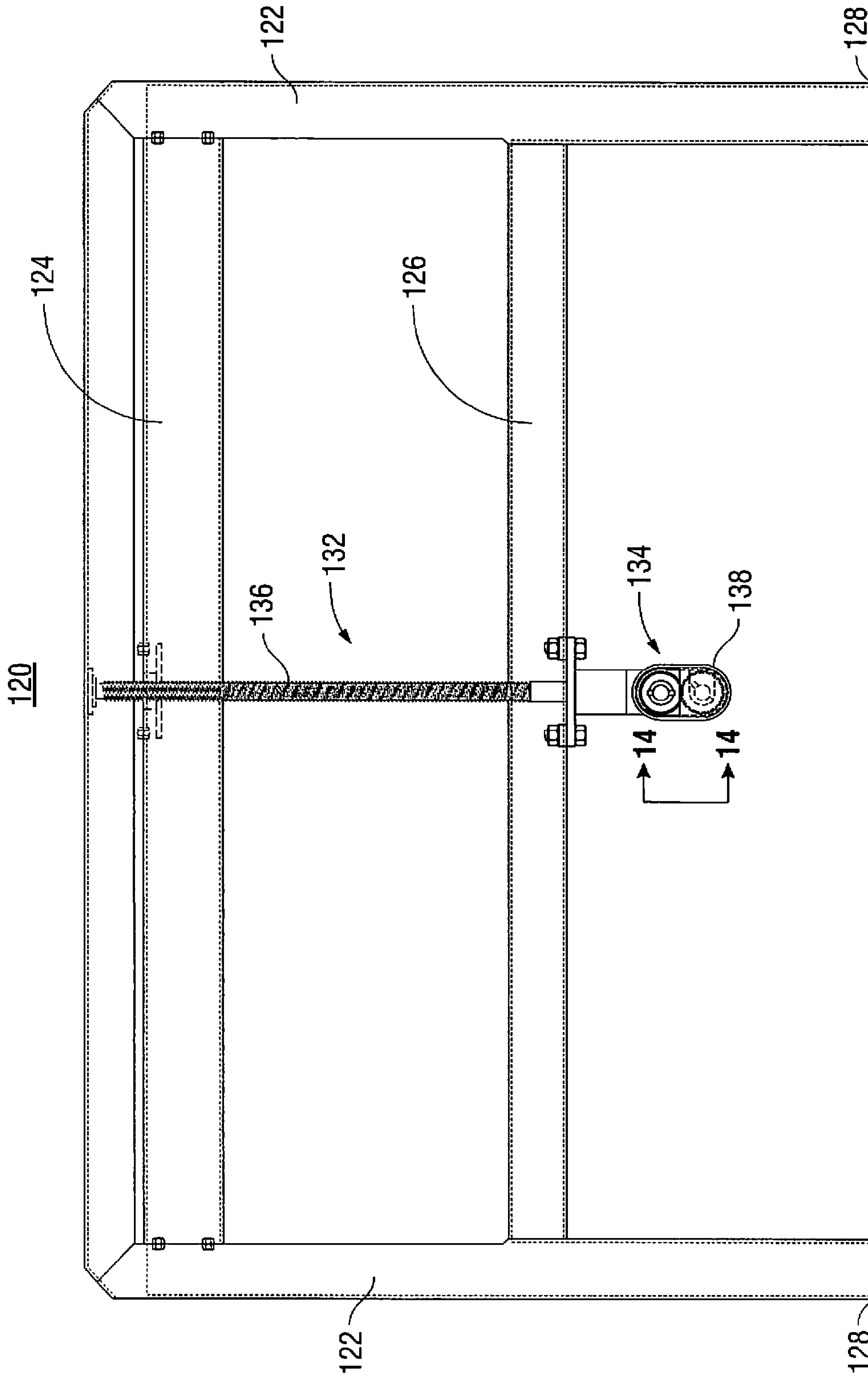


FIG. 13

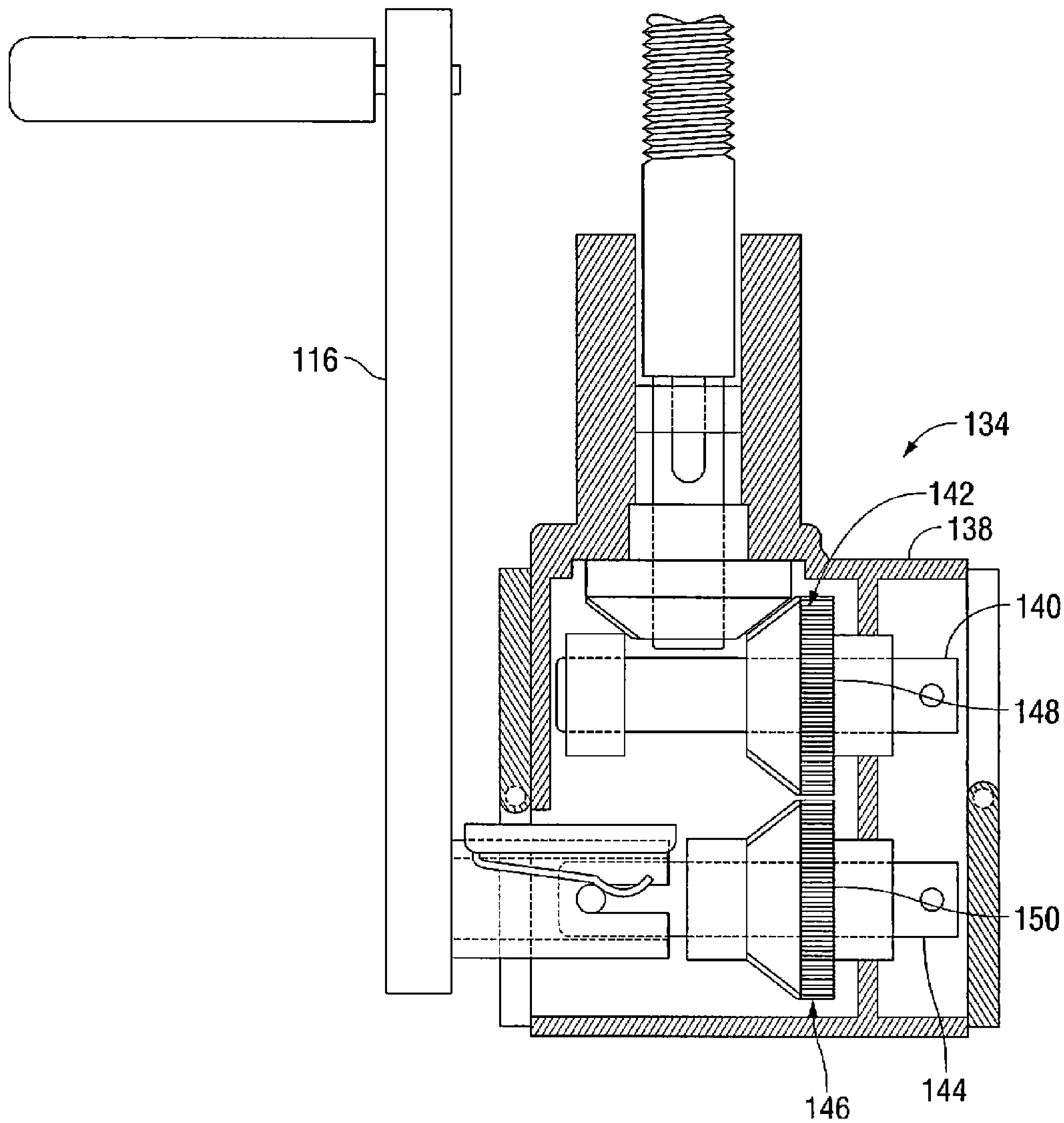


FIG. 14

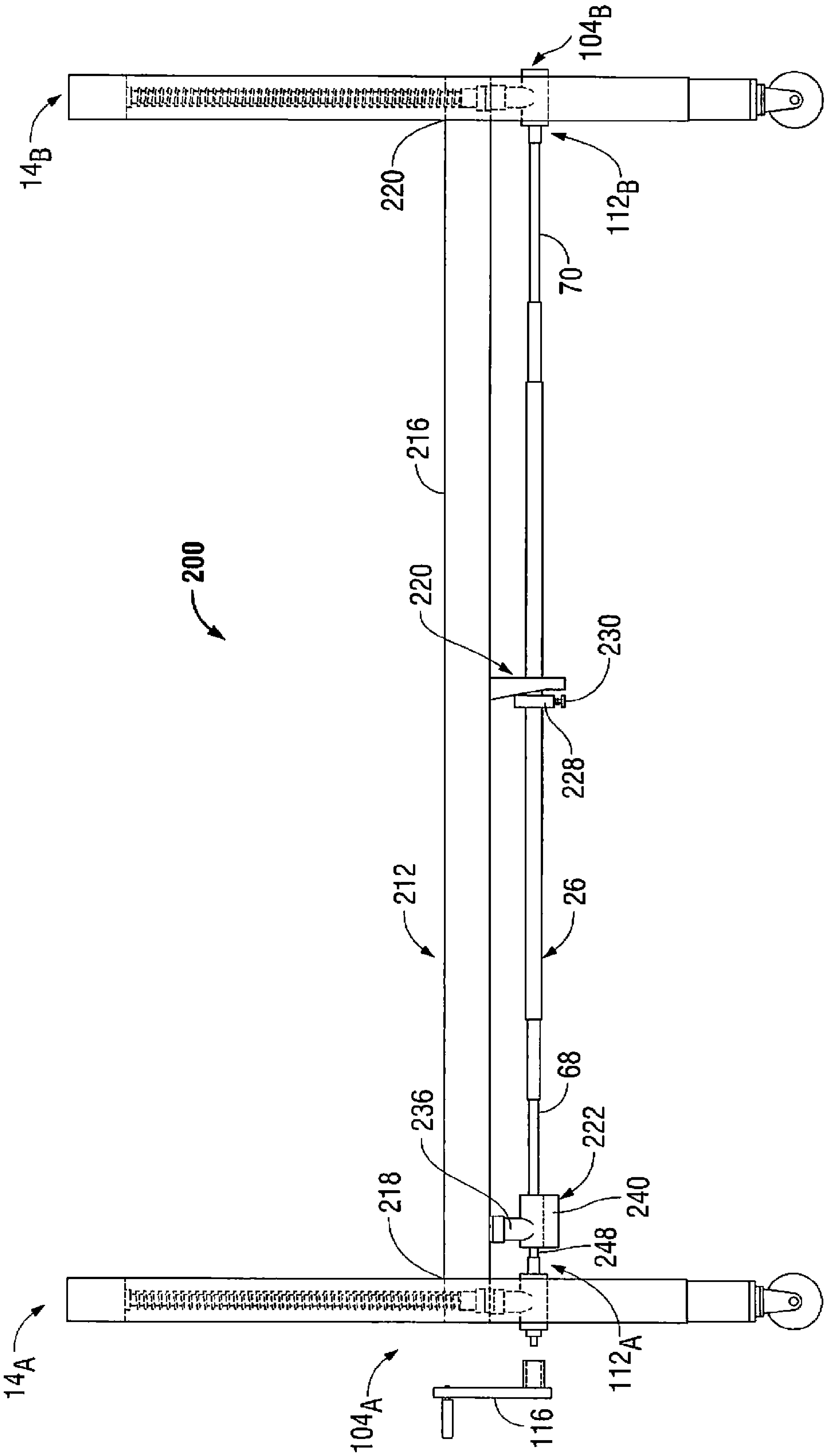

200
14_B
104_B
220
112_B
70
216
220
230
228
212
26
68
236
222
218
240
248
14_A
112_A
104_A
116

FIG. 15

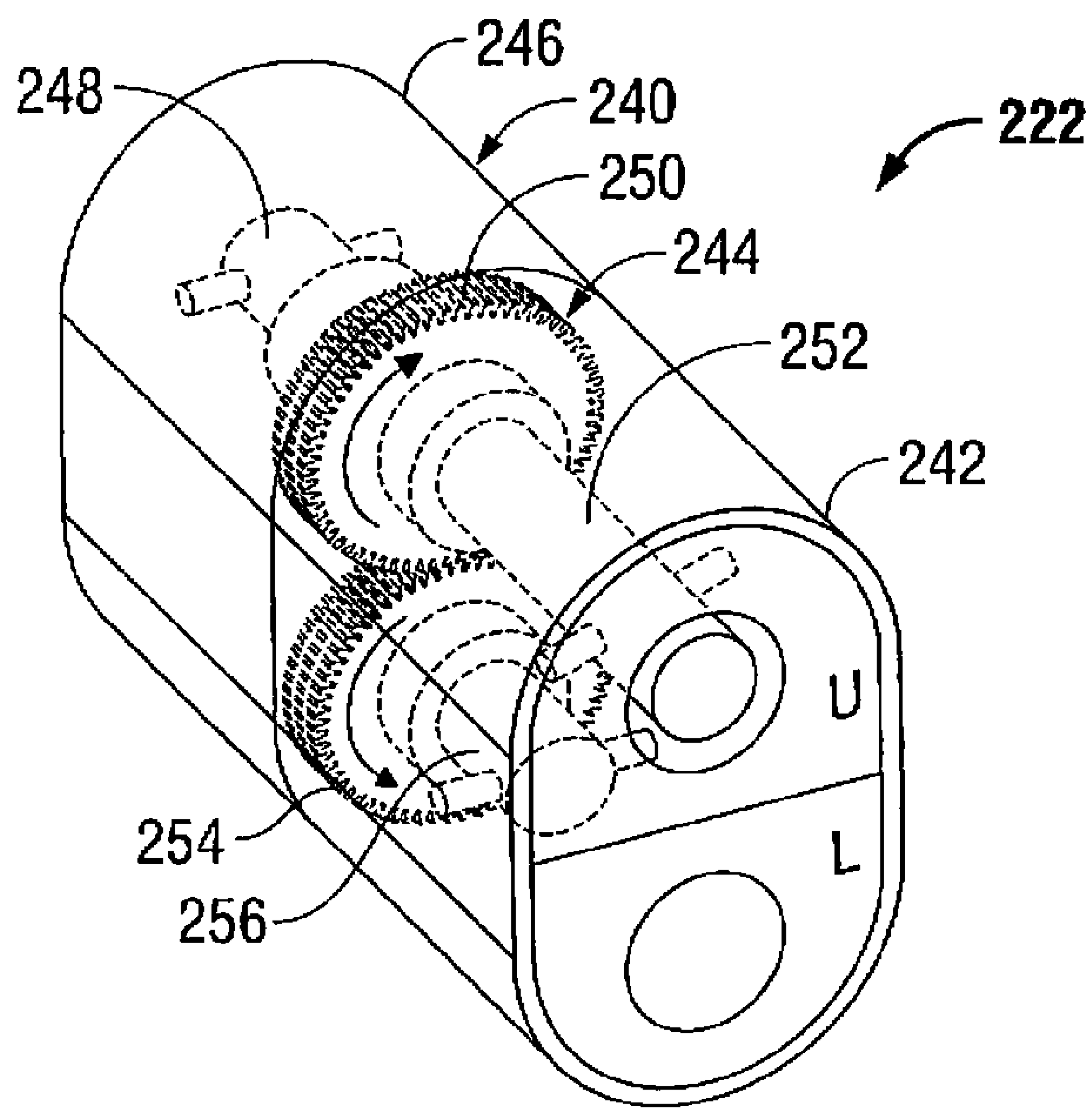

246
248
240
222
250
244
252
242
U
L
254
256

FIG. 16

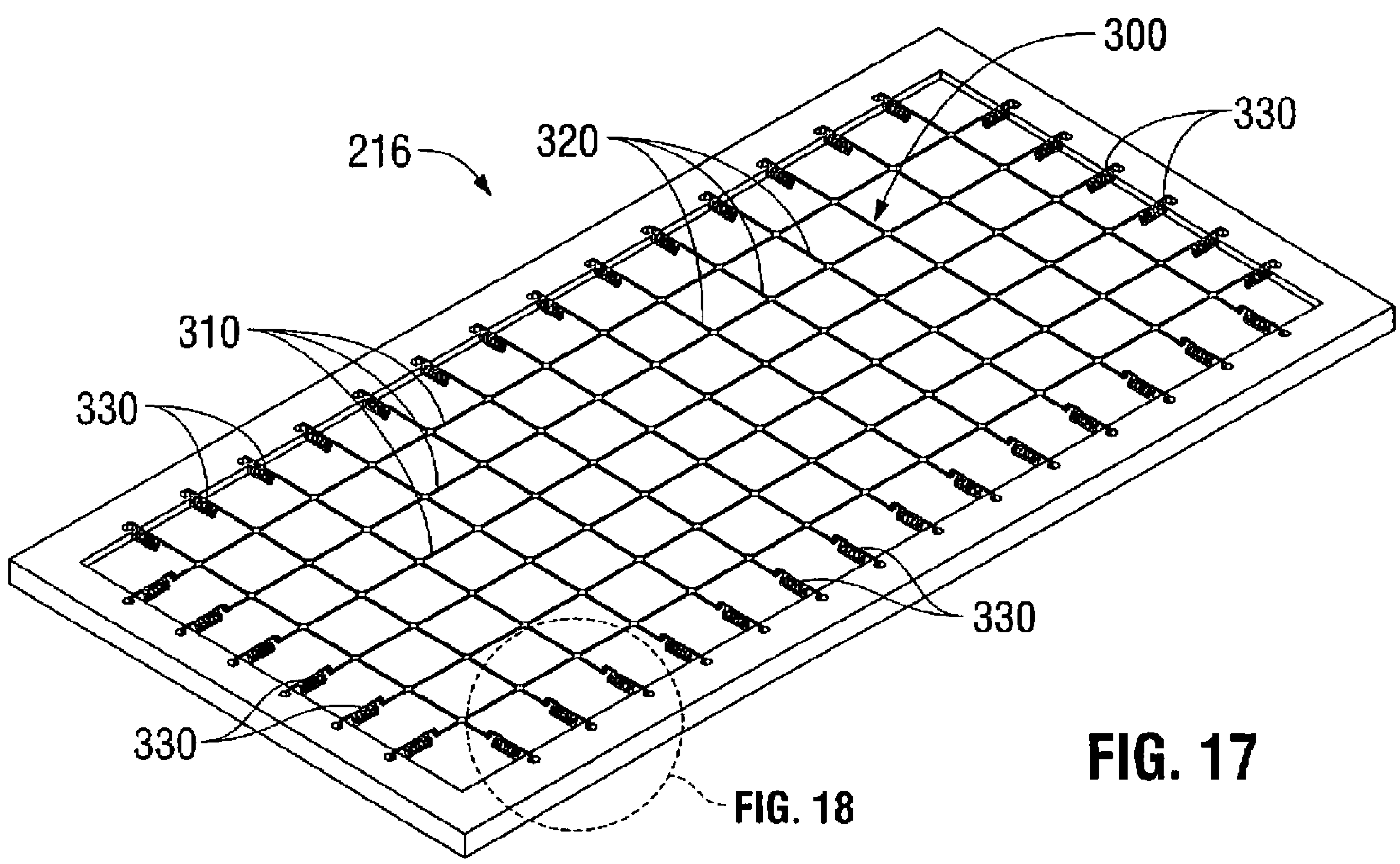

300
216
320
330
310
330
330
330
FIG. 18

FIG. 17

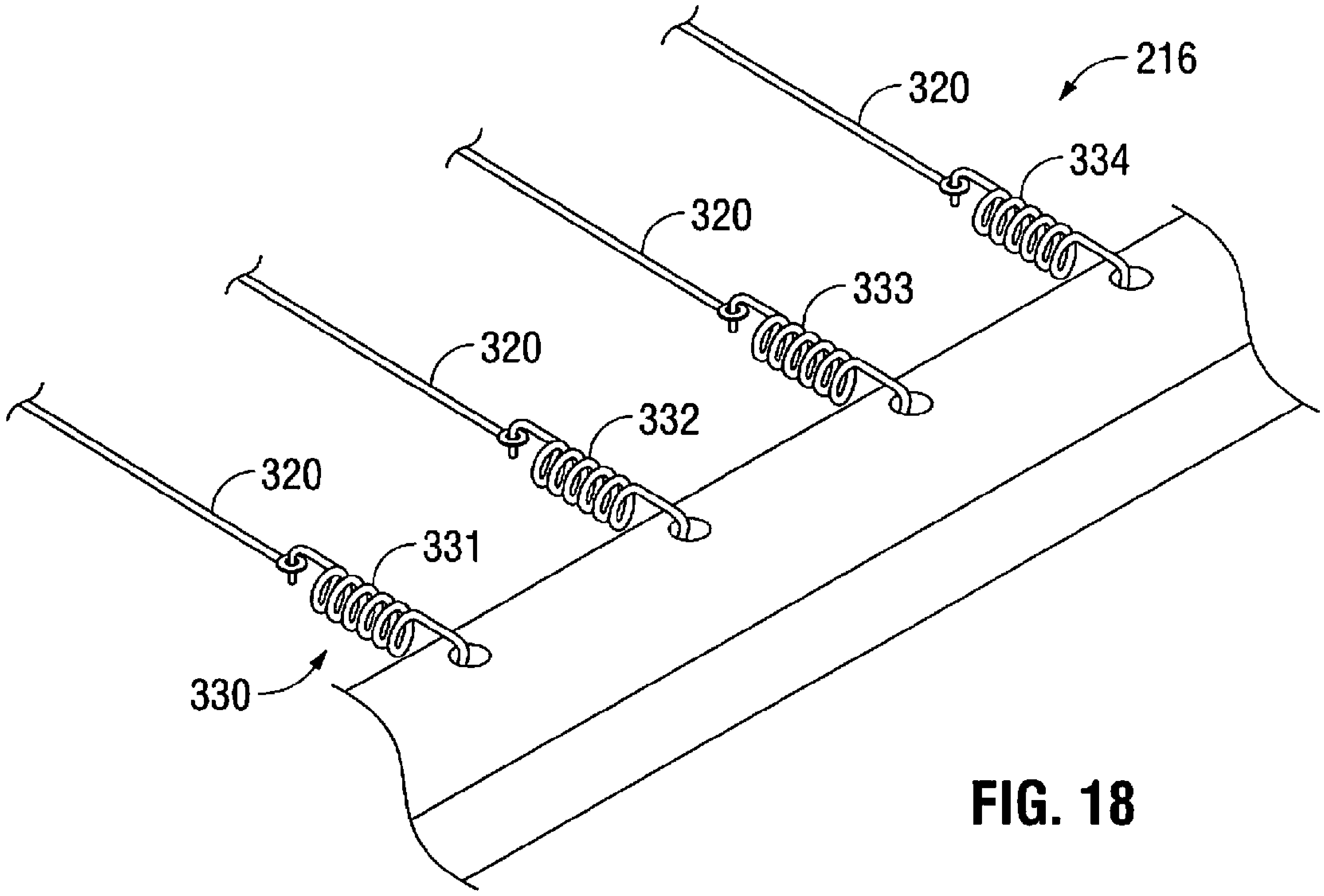

216
320
334
320
333
320
332
320
331
330

FIG. 18

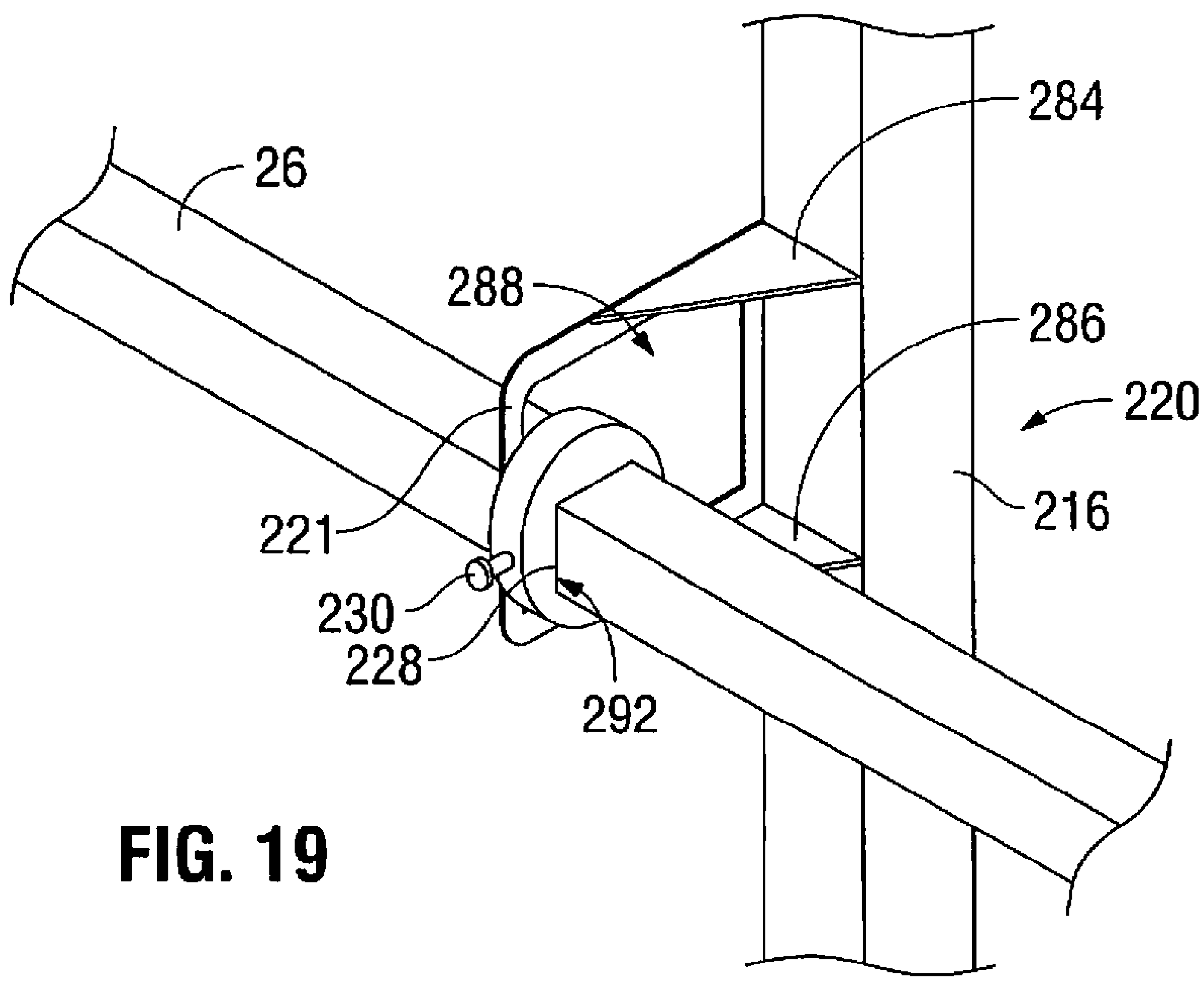

284
26
288
286
220
216
221
230
228
292

FIG. 19

UNIVERSAL BED SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority to, and benefit of, U.S. Provisional Patent Application No. 61/333,096 entitled "Universal Bed System" filed on May 10, 2010, the entire contents of which are hereby incorporated by reference herein.

BACKGROUND

1. Technical Field

The present disclosure relates to an adjustable bed system, and more particularly, to an adjustable bed system with a bed frame that is adjustable in height.

2. Background of Related Art

Adjustable beds are often used in both home care, and in more formalized medical settings, e.g., hospital rooms. Adjustable beds generally include a pair of end boards, i.e., a headboard and a footboard, a bed frame that extends between the end boards to support a mattress, and a mechanism that allows the height of the bed frame to be adjusted between the end boards so that the bed frame, and thus the mattress and patient, can be raised and lowered.

Various height adjustment mechanisms are known in the art, and typically include a pair of transition boxes, or gearboxes, that are positioned on the end boards, i.e., one transition box on the footboard, and another transition box on the headboard. The transition boxes include internal gearing mechanisms, and are connected to drive screws extending vertically through the end boards such that upon actuation of the transition boxes, the drive screws rotate to either raise or lower the bed frame dependent upon the direction of rotation. One example of such an arrangement is described in U.S. Pat. No. 5,134,731 (hereinafter "the '731 patent").

Adjustable bed systems can be either manually operated, or automatic. Manual systems utilize transition boxes that are operated via a hand crank, for example, whereas automated systems regulate operation of the transition boxes via an electric motor. In both manual and automated systems known in the art, the transition boxes are arranged on the end boards so that they face each other when the system is assembled. A drive shaft extends between, and connects, the transition boxes so that the actuation of one transition box causes corresponding actuation of the other. More specifically, since the drive shaft is connected to both the transition boxes, actuating one of the transition boxes causes rotation of the drive shaft, which thereby transmits a rotational force to the other transition box to the cause simultaneous actuation.

In adjustable bed systems such as that described in the '731 patent, the end boards are different, in that the transition boxes included on the headboard and the footboard are configured for rotation in opposite directions during use. However, such systems have led to inefficiencies during delivery and assembly. For example, on the occasion that two headboards or two footboards are inadvertently delivered, as opposed to one headboard and one footboard, the system would not function properly upon assembly, if at all. In order to remedy the predicament, the bed system would have to be disassembled, and the appropriate parts, i.e., either the missing headboard or footboard, would have to be re-delivered, resulting in not only increased operational costs, but customer dissatisfaction as well.

Systems such as those described in U.S. Pat. Nos. 6,983,495, 6,997,082, 7,302,716, and 7,441,289 have attempted to prevent such delivery and assembly issues via the development of identical headboards and footboards. Utilizing identical headboards and footboards reduces manufacturing costs, while also eliminating the chance for delivery of an improper end board. These systems, however, are incompatible with systems such as those described in the '731 patent.

Accordingly, the present disclosure is directed to an improved adjustable bed system, and in particular, to an improved bed frame, that is universal in the sense that it can be used with different end boards, such as those described in the '731 patent, as well as with identical end boards, such as those described in U.S. Pat. Nos. 6,983,495, 6,997,082, 7,302,716, and 7,441,289.

SUMMARY

In one aspect of the present disclosure, an adjustable bed system is disclosed that includes first and second end boards, which may be either identical or different in structure and operation, each having an independent height adjustment mechanism therein. The presently disclosed bed system also includes a frame assembly having a frame that is configured and dimensioned to be secured to the first and second end boards. More particularly, the frame assembly is configured and dimensioned to be secured to the first end board at a first end thereof. and to the second end board at a second end thereof. The frame assembly includes a frame, and a transition box secured to the frame at the first end thereof. The transition box is operatively engagable with the height adjustment mechanism of the first end board. A drive shaft defining an adjustable length is coupled at a first end thereof to the transition box and at a second end thereof to the second end board. The drive shaft is operable to facilitate uniform height adjustment of the first and second end boards.

In one embodiment, the drive shaft includes a center portion, and a plurality of outer portions extending from the center portion. The center portion and the outer portions are connected in telescoping arrangement to facilitate selective variation of the length of the drive shaft.

In another embodiment, the transition box includes a housing having first and second inputs at one end thereof. Each input has a gear selectively couplable to the first end of the drive shaft. The gears disposed in meshed engagement with one another. The transition box further includes a rod extending outwardly from the other end thereof that is coupled to the gear of the first input and is engaged to the height adjustment mechanism of the first end board.

In yet another embodiment, the transition box includes markings on an outer periphery of the housing and adjacent to one or both of the first and second inputs to distinguish the first and second inputs from one another.

In still another embodiment, the gears of the first and second inputs are disposed in vertical registration relative to one another.

In still yet another embodiment, the first and second end boards are identical in structure. In such an embodiment, the drive shaft is coupled to the gear of the second input of the transition box such that the rod and the drive shaft are rotatable in opposite directions to effect uniform height adjustment of the first and second end boards. Alternatively, the bed system may be configured for use with different end boards. In this embodiment, the drive shaft is coupled to the gear of the first input of the transition box such that the rod and the drive shaft are rotatable in similar directions to effect uniform height adjustment of the first and second end boards.

In another embodiment, the length of the drive shaft is adjusted to accommodate usage of various different end

boards with the frame assembly and/or to accommodate engaging the drive shaft within a plurality of inputs of the transition box.

In yet another embodiment, the bed system further includes a bracket member engaged to the frame and extending from an underside thereof. The bracket member is configured and dimensioned to receive the drive shaft at least partially therethrough to inhibit relative movement between the drive shaft and the frame.

In still another embodiment, one or more components of the frame assembly are color-coded to help identify an attachment position on the frame, e.g., for attaching a side rail thereto.

In accordance with another embodiment of the present disclosure, a frame assembly for use in an adjustable bed system including a first end board with a first height adjustment mechanism therein and a second end board with a second height adjustment mechanism therein is provided. The frame assembly includes a frame, a drive shaft and a bracket member. The drive shaft extends along a length of the frame and is coupled to the height adjustment mechanisms of the first and second end boards. The drive shaft is operable to facilitate uniform height adjustment of the first and second end boards. The bracket member is engaged to the frame on an underside thereof and defines one or more openings therethrough that are configured and dimensioned to at least partially receive the drive shaft therethrough to inhibit relative movement between the drive shaft and the frame.

In one embodiment, the frame assembly further includes a ring member including an opening extending therethrough configured and dimensioned to receive the drive shaft. The ring member defines an outer dimension larger than an inner dimension of the one or more openings of the bracket member such that the ring member is prevented from passing through the opening(s) in the bracket member to help inhibit relative movement between the drive shaft and the frame. The ring member may further include a screw member that is repositionable relative to the ring member to vary the opening extending through the ring member, thereby selectively inhibiting relative movement between the drive shaft and the ring member.

In another embodiment, the bracket member includes a first end with a first side opening defining an inner dimension, and a second end with a second side opening defining an inner dimension. The first and second side openings are configured and dimensioned to permit passage of the drive shaft therethrough.

In yet another embodiment, the bracket member includes a plate having a pair of wings extending therefrom for engaging the bracket member to the frame. The plate includes an opening defined therethrough that is configured and dimensioned to permit passage of the drive shaft therethrough.

In still another embodiment, the drive shaft defines an adjustable length such that the drive shaft may be selectively adjustable between a first length and a second length for coupling to various different types of end boards and/or coupling to the first and second end boards in different positions.

In still yet another embodiment, one or more components of the frame assembly are color-coded to identify an attachment position on the frame, e.g., for attachment of side rails thereto.

These and other features of the presently disclosed subject matter will become more readily apparent to those skilled in the art through reference to the detailed description of the various embodiments provided below, and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Various embodiments of the presently disclosed adjustable bed system, frame assembly, and components thereof will be described herein below with reference to the accompanying drawings, wherein:

FIG. **1** is a side view of an adjustable bed system according to the principles of the present disclosure that includes a pair of end boards, and a frame assembly;

FIG. **2** is a top, perspective view of the presently disclosed bed system with parts separated;

FIG. **3** is an end view of a transition box component of the presently disclosed frame assembly;

FIG. **4** is a side, schematic view of the transition box shown in FIG. **3**;

FIG. **5** is an end, perspective view of the transition box shown in FIG. **3**;

FIG. **6** is a partial, bottom view of the presently disclosed frame assembly illustrating a drive shaft, a cage structure, a ring member, and a screw member;

FIG. **7** is a top, perspective view of the presently disclosed bed system;

FIG. **8** is a bottom, perspective view of the presently disclosed bed system;

FIG. **9** is an enlarged view of the area of detail indicated in FIG. **7**;

FIG. **10** is a front view of one embodiment of an end board for use in the presently disclosed bed system;

FIG. **11** is a partial, side, cross-sectional view taken along line **11-11** in FIG. **10** illustrating a gear assembly included on the end board of FIG. **10** shown in conjunction with a hand crank;

FIG. **12** is a partial, perspective view of the presently disclosed bed system with parts separated;

FIG. **13** is a front view of an alternative embodiment of an end board for use in the presently disclosed bed system;

FIG. **14** is a side, cross-sectional view taken along line **14-14** in FIG. **13** illustrating a gear assembly included on the end board of FIG. **13** shown in conjunction with a hand crank;

FIG. **15** is a side view of another embodiment of an adjustable bed system according to the present disclosure;

FIG. **16** is an end, perspective view of the transition box of the adjustable bed system of FIG. **15**;

FIG. **17** is a top, perspective view of the bed frame of the adjustable bed system of FIG. **15**;

FIG. **18** is an enlarged, perspective view of the area of detail of FIG. **17**; and

FIG. **19** is an enlarged, perspective view of a bracket member configured for use with the adjustable bed system of FIG. **15**.

DESCRIPTION OF VARIOUS EMBODIMENTS

Various exemplary embodiments of the presently disclosed subject matter will now be described in detail with reference to the drawings, wherein like references characters identify similar or identical elements.

FIGS. **1** and **2** illustrate one embodiment of a universal, adjustable bed system **10** according to the principles of the present disclosure. The bed system **10** will find application in not only a hospital setting, but in private home care settings as well. The bed system **10** includes a frame assembly **12**, and a pair of end boards $\mathbf{14}_A$, $\mathbf{14}_B$ that are secured to opposite ends of the frame assembly **12**. The bed system **10** is adjustable in the sense that the height of the bed system **10**, and more particularly, the height of the frame assembly **12**, can be uniformly varied across the length "L" (FIG. **2**) of the frame assembly **12**. Throughout the present disclosure, the term "height" should be understood as referring to the vertical position of a particular component of the presently disclosed bed system **10**, i.e., to the vertical distance between a particular component, and the surface on which the bed system **10** stands.

The frame assembly **12** includes a frame **16** with respective first and second ends **18**, **20**, first and second transition boxes, which are respectively identified by the reference characters $\mathbf{22}_A$ and $\mathbf{22}_B$, a bracket member, or cage structure **24**, a drive shaft **26**, a ring member **28**, and a screw member **30**. In other embodiments, as will be described below with reference to FIGS. **15-16**, bed system **200** may be configured for use with only one transition box **222**.

The first end **18** of the frame **16** is secured to the end board $\mathbf{14}_A$, and the second end **20** of the frame **16** is secured to the end board $\mathbf{14}_B$. Throughout the present disclosure, the frame **16** will be described as being releasably secured to the end boards $\mathbf{14}_A$, $\mathbf{14}_B$. It is envisioned that the releasable connection between the frame **16** and the end boards $\mathbf{14}_A$, $\mathbf{14}_B$ may be established through the employ of any suitable means, e.g., via a plurality of brackets, screws, pins, or the like. However, it should be appreciated that, in alternative embodiments of the present disclosure, the frame **16** may be fixed to the end boards $\mathbf{14}_A$, $\mathbf{14}_B$, e.g., via a series of welds, without departing from the scope of the preset disclosure.

The frame **16** is formed from a plurality of interconnected strut members **32** (FIG. **2**) and cross members **34**, and is configured and dimensioned to support a mattress (not shown), or other such structure. As is conventional and known in the art, it is envisioned that the strut members **32** and the cross members **34** may be connected to allow for adjustments in the configuration of the frame **16**. For example, it is envisioned that the strut members **32** may include sections that are pivotably connected together to allow the height of the respective first and second ends **18**, **20** of the frame **16** to be increased or decreased, to thereby elevate or lower a patient's head and/or feet. It is further envisioned that the configuration of the frame **16** may be adjusted either manually or automatically, e.g., through the employ of a motor. In some embodiments, as will be described in detail below, the frame may include a resilient metallic mesh **300** (FIGS. **17-18**) disposed thereon to support to the matters (not shown).

With reference now to FIGS. **1-5**, the transition boxes $\mathbf{22}_A$, $\mathbf{22}_B$ will be described. The internal structure, external structure, and operation of the transition box $\mathbf{22}_A$ is identical to that of the transition box $\mathbf{22}_B$. Accordingly, while the transition boxes $\mathbf{22}_A$, $\mathbf{22}_B$ are illustrated separated in FIGS. **3** and **5**, respectively, in the interests of brevity, only the transition box $\mathbf{22}_A$ will be described herein below. Embodiments wherein only a single transition box **222** (FIGS. **15-16**) is provided will be described below, although many of the features of transition boxes $\mathbf{22}_A$, $\mathbf{22}_B$ apply similarly to transition box **222** (FIGS. **15-16**).

The transition box $\mathbf{22}_A$ includes a mounting structure **36** that facilitates connection of the transition box $\mathbf{22}_A$ to the frame **16**, e.g., adjacent the first end **18** (FIGS. **1**, **2**). While the transition box $\mathbf{22}_A$ is illustrated as being secured to a cross-member **34** in FIGS. **1** and **2**, the transition box $\mathbf{22}_A$ may be secured to the frame **16** in any suitable location.

It is envisioned that the mounting structure **36** may secure the transition box $\mathbf{22}_A$ to the frame **16** in a manner that would allow for multidimensional adjustments in the position of the transition box $\mathbf{22}_A$. For example, in the embodiment of the frame assembly **12** seen in FIGS. **1-5**, the mounting structure **36** is illustrated as including a plurality of bolts **38** to secure the transition box $\mathbf{22}_A$ to the frame **16**. In this embodiment, it is contemplated that the frame **16** may include a plurality of openings (not shown) that are each configured and dimensioned to receive the bolts **38**, whereby the horizontal position of the transition box $\mathbf{22}_A$ can be adjusted, i.e., in the directions indicated by arrows **1** and **2** in FIG. **2**, by varying the openings into which the bolts **38** are inserted. It is further envisioned that by tightening and loosening the bolts **38**, the height of the transition box $\mathbf{22}_A$, i.e., the distance between the transition box $\mathbf{22}_A$ and the floor, could also be adjusted. It should be appreciated, however, that in alternative embodiments, the mounting structure **36** may be configured and dimensioned to secure the transition box $\mathbf{22}_A$ to the frame in another manner facilitating adjustment in the aforedescribed manner. Additionally, and in the alternative, it is envisioned that the mounting structure **36** may be configured and dimensioned to fixedly connect the transition box $\mathbf{22}_A$ to the frame **16** to substantially inhibit, if not completely prevent, relative movement between the transition box $\mathbf{22}_A$ and the frame **16**. For example, the mounting structure **36** may be secured to the frame **16** via a series of welds (not shown).

The transition box $\mathbf{22}_A$ further includes a housing **40** that accommodates the internal components thereof. The housing **40** includes a first end **42** (FIG. **3**) with an internal gear assembly **44**, and a second end **46** with a transmission rod **48** that extends outwardly therefrom.

The internal gear assembly **44** includes a first gear **50** that is supported on a first shaft **52**, and a second gear **54** that is supported on a second shaft **56**. As best seen in FIG. **3**, the respective first and second gears **50**, **54** are positioned in side-by-side, horizontal relation. Stated differently, the first shaft **52** and the first gear **50** are positioned the same distance from the frame **16** as the second shaft **56** and the second gear **54**. Alternatively, as shown in FIGS. **15-16**, first and second gears **250**, **254**, respectively, may be positioned in vertical alignment with one another.

The first and second gears **50**, **54** respectively include teeth **58**, **60** (FIGS. **3**, **5**) that are configured and dimensioned to facilitate mating engagement of the gears **50**, **54**, whereby rotation of one of the gears **50**, **54** causes corresponding rotation of the other, but in opposing directions. For example, with respect to FIG. **3**, rotation of the gear **50** in the direction indicated by arrow **3** will cause rotation of the gear **54** in the direction indicated by arrow **4**.

To facilitate identification and differentiation between the gears **50**, **54** and the shafts **52**, **56**, the housing **40** may optionally include visual markers M on an outer surface thereof. In the embodiment of the transition box $\mathbf{22}_A$ illustrated in FIG. **3**, for instance, the first gear **50** and first shaft **52** are identified by an "A," and the second gear **54** and second shaft **56** are identified by the letter "B." However, these visual makers M may include color-coding, letters, numbers, brief phrasing, symbols, or any other suitable marker that facilitates identification of a particular gear, or shaft of the transition box $\mathbf{22}_A$. Further, the visual markers M may be formed directly on the outer surface of housing **40**, or may be adhered, or otherwise disposed thereon, e.g., as stickers (not shown).

In the embodiment of the disclosure illustrated in FIGS. **1-5**, the housing **40** further includes a door **62** (FIG. **5**). The door **62** is configured and dimensioned to selectively obscure, and selectively reveal, either the first gear **50** or the second gear **54** for reasons that will be discussed below. In alternative embodiments, however, it is also envisioned that the door **62** may be configured and dimensioned to selectively obscure and reveal the respective first and second gears **50**, **54** simultaneously.

The transmission rod **48** extends away from the housing **40**, and is connected to the either the first shaft **52**, as illustrated in

FIGS. **3** and **4**, or the second shaft **56**, either directly, or via a series of mechanical engagements. Due to the mechanical connection of the transmission rod **48** to the first shaft **52**, rotation of the first shaft **52** causes corresponding rotation of the transmission rod **48**.

The transmission rod **48** defines a length "L_R" (FIG. **4**) that is selectively adjustable. For example, the present disclosure contemplates an adjustment in the length "L_R" of approximately 2". It is envisioned that variations in the length "L_R" of the transmission rod **48** may be accomplished through any suitable means. For example, the transmission rod **48** may include a plurality of telescoping portions (not shown) that would allow for movement of the transmission rod **48** towards and away from the housing **40**.

Additionally, as seen in FIG. **4**, the transmission rod **48** has a terminal end **64** that includes engagement structure **66**. The engagement structure **66** is configured and dimensioned for connection to corresponding structure included on the end boards **14**$_A$, **14**$_B$ (FIGS. **1**, **2**), as will be described in further detail below.

Since the transition boxes **22**$_A$, **22**$_B$ are identical in structure, it should be appreciated that the vertical position of the gear assembly **44** included in the transition box **22**$_A$ (FIG. **3**) is the same as that of the gear assembly (not shown) included in the transition box **22**$_B$ (FIG. **5**). Similarly, it should be appreciated that the vertical position of the transmission rod **48** extending from the transition box **22**$_A$ is the same as that of the transmission rod (not shown) extending from the transition box **22**$_B$.

With reference now to FIGS. **2** and **6**, the drive shaft **26** includes a first end **68** that is configured and dimensioned for selective engagement with the first transition box **22**$_A$, and a second end **70** that is configured and dimensioned for selective engagement with the second transition box **22**$_B$. More specifically, the ends **68**, **70** of the drive shaft **26** include structure that is configured and dimensioned for connection to the shafts **52**, **56** (FIGS. **3**, **5**) of the internal gear assemblies **44** positioned within the housing **40** of the transition boxes **22**$_A$, **22**$_B$. In the particular embodiment of the drive shaft **26** seen in FIGS. **2** and **6**, for example, the ends **68**, **70** of the drive shaft **26** each include a slot **72** that is configured and dimensioned to receive protrusions **74** (FIGS. **3-5**) that extend radially outward from each of the shafts **52**, **56**. The protrusions **74** are fixedly connected to the shafts **52**, **56** such that rotation of the shafts **52**, **56** causes corresponding rotation of the protrusions **74**, which, in turn, causes corresponding rotation of the drive shaft **26** via engagement of the protrusions **74** and the slots **72**. In various embodiments of the present disclosure, it should be understood that the structures included on the drive shaft **26** and the shafts **52**, **56** establishing a releasable connection therebetween may be varied without departing from the scope of the present disclosure.

With continued reference to FIGS. **2** and **6**, the drive shaft **26** defines a length "L_S," and includes a central portion **76**, as well as outer portions **78**, **80**. In the illustrated embodiment of the drive shaft **26**, the outer portions **78**, **80** are configured and dimensioned for telescopic movement to facilitate variation in the length "L_S" of the drive shaft **26**. Specifically, as illustrated, the outer portions **80** are configured and dimensioned for reception by the outer portions **78**, and the outer portions **78** are configured and dimensioned for reception by the central potion **76**.

Additionally, the drive shaft **26** includes structure that is configured and dimensioned to maintain a particular length "L_S" of the drive shaft **26**. For example, in the embodiment of the drive shaft **26** seen in FIG. **2**, the central portion **76** of the drive shaft **26** includes a plurality of openings **82** that are configured and dimensioned to receive depressible buttons **84** that are included on the outer portions **78**, **80**. During movement of the outer portions **78**, **80** relative to the central portion **76** of the drive shaft **26**, the buttons **84** engage the openings **82**, thereby maintaining a particular length "L_S" of the drive shaft **26**. To adjust the length "L_S" of the drive shaft **26**, the buttons **84** can be depressed out of engagement with the openings **82**, whereby the outer portions **78**, **80** can again be moved relative to the central portion **76**.

While the drive shaft **26** is illustrated as including a substantially square cross-sectional configuration, the configuration of the drive shaft **26** may be varied in alternative embodiments without departing from the scope of the present disclosure. Additionally, although illustrated as including the aforedescribed telescoping central portion **76** and outer portions **78**, **80**, an embodiment of the drive shaft **26** defining a fixed length would not be beyond the scope of the present disclosure. Further, at least a portion of drive shaft **26** may be spring-biased toward a more-extended position, the importance of which will be described in greater detail below. More specifically, a spring (not shown) may be disposed within drive shaft **26** to bias one or more of the telescoping portions outwardly from one another.

With reference now to FIGS. **6-9**, the bracket member, or cage structure **24** will be described. The cage structure **24** is secured to the frame **16** on an underside thereof, and is configured and dimensioned to inhibit relative movement between the drive shaft **26** and the frame **16**, e.g., during transport. The cage structure **24** includes respective first and second side openings **86**, **88** (FIGS. **8**, **9**) that are configured and dimensioned to allow the drive shaft **26** to pass therethrough, and defines a substantially U-shaped cross-sectional configuration describing an open bottom portion **89** (FIG. **6**). As can be appreciated through reference to FIG. **9**, each side opening, e.g., the side opening **86**, includes a first inner dimension D_1, and a second inner dimension D_2. Upon proper connection of the cage structure **24** to the frame **16**, the first inner dimension D_1 extends vertically, and the second inner dimension D_2 extends horizontally. The second (horizontal) inner dimension D_2 is such that the position and/or orientation of the drive shaft **26** can be adjusted within the cage structure **24**. As seen in FIGS. **7** and **8**, for example, the drive shaft **26** can be separated from the transition boxes **22**$_A$, **22**$_B$, and rotated within the cage structure **24** such that the drive shaft **26** is skewed relative to the frame **16** in order to prevent any damage to the gear assemblies **44** (FIGS. **3-5**) of the transition boxes **22**$_A$, **22**$_B$ during transport. Thereafter, the drive shaft **26** can secured to the frame via an optional securement member **90** (FIG. **8**), e.g., a length of Velcro, string, or tape, a clamp, or the like, to further inhibit relative movement between the drive shaft **26** and the frame **16**.

With continued reference to FIGS. **6-9**, the ring member **28** is configured and dimensioned for positioning within the cage structure **24** via the open bottom portion **89** (FIG. **6**) of the cage structure **24**. The ring member **28** includes an opening **92** (FIGS. **2**, **9**) extending therethrough that is configured and dimensioned to receive the drive shaft **26**. It is envisioned that the cross-sectional configuration of the opening **92** extending through the screw member **30** may correspond to that of the drive screw **26**, e.g., to inhibit relative rotational movement between the ring member **28** and the drive shaft **26**. For example, in the embodiment of the drive shaft **26** and the ring member **28** seen in FIGS. **2** and **6**, the drive shaft **26** and the opening **92** extending through the ring member **28** are each illustrated as including substantially square cross-sectional configurations. However, alternative cross-sectional configurations for the drive shaft **26** and the opening **92**, e.g., elliptical or circular, are not beyond the scope of the present disclosure.

The ring member **28** is configured and dimensioned for cooperative engagement with the aforementioned screw member **30** to inhibit relative movement between the drive shaft **26** and the ring member **28**. Specifically, by rotating the screw member **30** relative to the ring member **28**, the screw member **30** can be brought into and out of engagement with the drive shaft **26** to fix the position of the drive shaft **26** relative to the ring member **28**.

With reference to FIG. **9** in particular, the ring member **28** defines an outer dimension D_O that is larger than the first (vertical) inner dimension D_1 of the side openings formed in the cage structure **24**, e.g., the side opening **86** seen in FIG. **9**. As such, when the ring member **28** is positioned within the cage structure **24**, and about the drive shaft **26**, after tightening of the screw member **30** into engagement with the drive shaft **26**, the ring member **28**, and consequently, the drive shaft **26**, is prevented from passing through the side openings **86**, **88** formed in the cage structure **24**.

With reference now to FIGS. **1**, **2**, **10**, and **11**, the end boards $\mathbf{14}_A$, $\mathbf{14}_B$ will be described. The end board $\mathbf{14}_A$ is positioned at the "foot" of the frame assembly **12**, and includes a pair of legs **94** that are connected by an upper cross member **96** (FIGS. **2**, **10**) and a lower cross member **98**. The legs **94** each include an internal hollow portion (not shown) that is configured and dimensioned to receive an inner member **100** such that the legs **94** are vertically movable relative to the inner members **100**. As shown, the inner members **100** each include a wheel **102** at their base, which facilitates movement of the bed system **10** as required.

The end board $\mathbf{14}_A$ further includes a height adjustment mechanism $\mathbf{104}_A$ (FIGS. **1**, **10**), such as that which is described in the '731 patent (U.S. Pat. No. 5,134,731). The height adjustment mechanism $\mathbf{104}_A$ facilitates movement of the legs **94** relative to the inner members **100**, and thus, adjustments in the height of the first end board $\mathbf{14}_A$. Given the respective connection between the first and second ends **18**, **20** of the frame **16** and the end boards $\mathbf{14}_A$, $\mathbf{14}_B$, any adjustments in the height of the end boards $\mathbf{14}_A$, $\mathbf{14}_B$ will cause a corresponding adjustment in the height of the frame **16**.

Although specific details regarding the structure and functionality of the height adjustment mechanism $\mathbf{104}_A$ can be ascertained through reference to the '731 patent, the height adjustment mechanism $\mathbf{104}_A$ will be discussed briefly herein below.

The height adjustment mechanism $\mathbf{104}_A$ includes a rotatable drive screw $\mathbf{106}_A$ that is secured to the upper cross member **96** (FIGS. **2**, **10**) and the lower cross member **98**. The drive screw $\mathbf{106}_A$ is connected to a gear assembly $\mathbf{108}_A$, whereby actuation of the gear assembly $\mathbf{108}_A$ causes rotation of the drive screw $\mathbf{106}_A$ to adjust the height of the end board $\mathbf{14}_A$.

With particular reference to FIGS. **10** and **11**, the gear assembly $\mathbf{108}_A$ includes an input assembly $\mathbf{110}_A$ that is operatively connected to an output assembly $\mathbf{112}_A$. The input assembly $\mathbf{110}_A$ includes a nut **114** that is configured and dimensioned for connection to a rotatable hand crank **116**, such that rotation of the hand crank **116** effectuates corresponding rotation of the output assembly $\mathbf{112}_A$, as well as rotation of drive screw $\mathbf{106}_A$ via connection of the drive screw $\mathbf{106}_A$ to the gear assembly $\mathbf{108}_A$. While the gear assembly $\mathbf{108}_A$ is configured and dimensioned for manual actuation in the embodiment seen in FIGS. **1**, **2**, **10**, and **11**, the use of an electric motor to control actuation of the gear assembly $\mathbf{108}_A$ in alternative embodiments is also contemplated.

Dependent upon the particular direction of actuation of the gear assembly $\mathbf{108}_A$, e.g., the direction of rotation of the hand crank **116** in FIG. **11**, the output assembly $\mathbf{112}_A$ will be caused to rotate either in the direction indicated by arrow **3** (FIG. **10**), or in the direction indicated by arrow **4**. Additionally, the drive screw $\mathbf{106}_A$ will be caused to rotate such that the legs **94** of the end board $\mathbf{14}_A$ are moved either up, to thereby increase the height of the end board $\mathbf{14}_A$ and the frame **16** (FIGS. **1**, **2**), or down, to thereby reduce the height of the end board $\mathbf{14}_A$ and the frame **16** (FIGS. **1**, **2**).

As best seen in FIG. **10**, the output assembly $\mathbf{112}_A$ includes receipt structure $\mathbf{118}_A$ that is configured and dimensioned for mechanical connection to the engagement structure **66** (FIG. **4**) included at the terminal end **64** of the transmission rod **48** component of the transition box $\mathbf{22}_A$. In this manner, a rotational force applied to the gear assembly $\mathbf{108}_A$ of the height adjustment mechanism $\mathbf{104}_A$, e.g., by rotation of the nut **114** (FIG. **11**) via the crank **116**, will be transmitted to the transmission rod **48** through the output assembly $\mathbf{112}_A$. Given the connection of the transmission rod **48** to the first shaft **52** (FIG. **4**) of the internal gear assembly **44** included in the transition box $\mathbf{22}_A$, rotation of the transmission rod **48** will effectuate corresponding rotation of the first shaft **52**, and consequently, rotation of the first and second gears **50**, **54** (FIG. **4**).

With momentary reference to FIGS. **1** and **2**, the end board $\mathbf{14}_B$ will be described. The end board $\mathbf{14}_B$ is positioned at the "head" of the frame assembly **12**, and is substantially similar to the first end board $\mathbf{14}_A$, but for the differences detailed below. Given the similarities between the end boards $\mathbf{14}_A$, $\mathbf{14}_B$, the end board $\mathbf{14}_B$ will only be discussed to the extent that it differs from the end board $\mathbf{14}_A$.

The end board $\mathbf{14}_B$ includes a height adjustment mechanism $\mathbf{104}_B$ with a rotatable drive screw $\mathbf{106}_B$ that is connected to a gear assembly $\mathbf{108}_B$. The gear assembly $\mathbf{108}_B$ includes an input assembly $\mathbf{110}_B$ and an output assembly $\mathbf{112}_B$.

Upon assembly of the bed system **10**, the end boards $\mathbf{14}_A$, $\mathbf{14}_B$ will be positioned as illustrated in FIGS. **1** and **2**. More specifically, the end boards $\mathbf{14}_A$, $\mathbf{14}_B$ will be positioned such that output assembly $\mathbf{112}_A$ of the gear assembly $\mathbf{108}_A$ included on the end board $\mathbf{14}_A$ faces the output assembly $\mathbf{112}_B$ of the gear assembly $\mathbf{108}_B$ included on the end board $\mathbf{14}_B$.

During use, a rotational force will be transmitted through the drive shaft **26** (FIGS. **1**, **2**) from the height adjustment mechanism $\mathbf{104}_A$ of the end board $\mathbf{14}_A$ to the height adjustment mechanism $\mathbf{104}_B$ of the end board $\mathbf{14}_B$, the particular details of which will be discussed herein below. However, since the end boards $\mathbf{14}_A$, $\mathbf{14}_B$ face each other upon assembly of the bed system **10** (FIGS. **1**, **2**), uniform adjustment in the height of the frame **16** across the length "L" of the frame **16** (FIG. **2**) will require that the respective output assemblies $\mathbf{112}_A$, $\mathbf{112}_B$ of the height adjustment mechanisms $\mathbf{104}_A$, $\mathbf{104}_B$ rotate in opposite directions. To facilitate rotation in opposite directions, the configuration of the gear assembly $\mathbf{108}_A$ is necessarily different from that of the gear assembly $\mathbf{108}_B$. Thus, the end board $\mathbf{14}_A$ differs from the end board $\mathbf{14}_B$ in the configuration of the gear assemblies $\mathbf{108}_A$, $\mathbf{108}_B$ of the respective height adjustment mechanisms $\mathbf{104}_A$, $\mathbf{104}_B$. Were the configurations of the gear assemblies $\mathbf{108}_A$, $\mathbf{108}_B$ identical, upon rotation of the crank **116** (FIG. **11**), the end boards $\mathbf{14}_A$, $\mathbf{14}_B$ would move in opposite directions, e.g., the height of the end board $\mathbf{14}_A$ would be increased, whereas the height of the end board $\mathbf{14}_B$ would be decreased, or vice versa.

With reference now to FIGS. **1-12**, the use and operation of the presently disclosed frame assembly **12** will be discussed in connection with the aforedescribed end boards $\mathbf{14}_A$, $\mathbf{14}_B$ (FIGS. **1**, **2**).

Initially, the end boards 14_A, 14_B are positioned as illustrated in FIGS. **1** and **2**, i.e., such that the output assembly 112_A (FIGS. **1**, **10**) of the height adjustment mechanism 104_A included on the end board 14_A faces the output assembly 112_B (FIGS. **1**, **2**, **12**) of the height adjustment mechanism 104_B included on the end board 14_B. Thereafter, the frame **16** is secured to the end boards 14_A, 14_B, and the transition boxes 22_A, 22_B are respectively connected to the height adjustment mechanisms 104_A, 104_B. More specifically, the transmission rod **48** (FIGS. **2-4**) of the transition box 22_A is connected to the output assembly 112_A, and the transmission rod **48** (FIGS. **2**, **5**) of the transition box 22_B is connected to the output assembly 112_B.

Either prior, or subsequent, to respective connection of the transition boxes 22_A, 22_B and the height adjustment mechanisms 104_A, 104_B of the end boards 14_A, 14_B, the drive shaft **26** (FIGS. **2**, **12**) is connected to the transition boxes 22_A, 22_B. Specifically, the door **62** (FIG. **3**) included on the housing **40** is adjusted to expose either the first gear **50**, i.e., the gear identified by the letter "A," or the second gear **54**, i.e., the gear identified by the letter "B." For the purposes of discussion, the drive shaft **26** will be described herein below as being connected to the first gear **50** of the transition box 22_A. However, it should be understood that, in the alternative, the drive shaft **26** may be connected to the second gear **54** without disrupting operation of the bed system **10**. To connect the drive shaft **26** to the first gear **50**, the slot **72** (FIGS. **6**, **12**) included at the first end **68** of the drive shaft **26** is positioned about the protrusions **74** (FIGS. **3**, **4**) that are included on the first shaft **52**.

At the opposite end of the frame **16**, the door **62** (FIG. **3**) included on the housing **40** of the second transition box 22_B (FIGS. **1**, **2**) is adjusted to expose one of the first and second gears **50**, **54**. In order to realize uniform adjustments in the height of the frame **16**, the drive shaft **26** must be connected to opposite gears in the transition boxes 22_A, 22_B. For instance, in the preceding example, since the first end **68** (FIGS. **2**, **6**) of the drive shaft **26** is described as being connected to the first gear **50**, i.e., the gear identified by the letter "A" (FIG. **3**) on the housing **40**, the second end **70** (FIGS. **2**, **6**) of the drive shaft **26** must be connected to the gear identified by the letter "B" on the housing **40** of the second transition box 22_B, i.e., the second gear **54**, as shown in FIG. **12**. Since the first gear **50** (FIG. **3**) of the first transition box 22_A and the second gear **54** (FIG. **5**) of the second transition box 22_B are configured for rotation in opposite directions, the force transmitted from the height adjustment mechanism 104_A (FIGS. **1**, **12**) through the transition boxes 22_A, 22_B and the drive shaft **26** will cause the drive screws 106_A, 106_B (FIGS. **1**, **2**, **12**) to rotate in opposite directions, thereby causing the end boards 14_A, 14_B (FIGS. **1**, **2**), and consequently, the frame **16**, to move in the same direction.

With primary reference now to FIGS. **3**, **5**, and **12**, following connection of the drive shaft **26** to the transition boxes 22_A, 22_B, a rotational force is applied to either of the height adjustment mechanisms 104_A, 104_B via one of the respective input assemblies 110_A, 110_B, e.g., via rotation of the hand crank **116**. In the description below, while the hand crank **116** will be discussed in connection with the height adjustment mechanism 104_A, it should be appreciated that, in the alternative, the hand crank **116** could be utilized in connection with the height adjustment mechanism 104_B without disrupting operation of the bed system **10**.

Upon rotation of the hand crank **116**, e.g., in the direction indicated by arrow **3** (FIG. **12**), the height of the end board 14_A (FIGS. **1**, **2**) will adjusted by the application of a rotational force to the drive screw 106_A. Given the particular direction of rotation of the hand crank **116**, i.e., the direction indicated by arrow **3** in FIG. **12**, the drive screw 106_A will be caused to rotate in the direction indicated by arrow A to thereby increase the height of the end board 14_A (FIGS. **1**, **2**), and consequently, the height of the first end **18** (FIG. **2**) of the frame **16**. The drive screw 106_A is caused to rotate due to (i) the connection of the input assembly 110_A (FIG. **12**), which engages the hand crank **116**, to the output assembly 112_A; and (ii) connection of the output assembly 112_A to the drive screw 106_A via the gear assembly 108_A (FIGS. **1**, **11**).

Concomitantly, with rotation of the drive screw 106_A, the transmission rod **48** of the transition box 22_A will be caused to rotate, also in the direction indicated by arrow **3** (FIG. **12**), due to the connection established via mechanical cooperation of the receipt structure 118_A (FIG. **10**) of the output assembly 112_A with the engagement structure **66** (FIG. **3**) included at the terminal end **64** of the transmission rod **48**. Rotation of the transmission rod **48** will effectuate corresponding rotation of the first shaft **52**, also in the direction indicated by arrow **3**, which will in turn cause rotation of the respective first and second gears **50**, **54** of the gear assembly **44**. More specifically, the respective first and second gears **50**, **54** will be caused to rotated in opposite directions, e.g., the first gear **50** will rotate in the direction indicated by arrow **3**, whereas the second gear **54** will rotate in the direction indicated by arrow **4**.

Since the first end **18** (FIG. **12**) of the drive shaft **26** engages the first shaft **52** of the gear assembly **44**, the drive shaft **26** will also be caused to rotate in the direction indicated by arrow **3**. The rotational force applied to the drive shaft **26** will be transmitted to the second transition box 22_B via the connection between the second end **20** of the drive shaft **26**, and the second shaft **56** (FIG. **5**) of the gear assembly **44**, whereby the second shaft **56** will be caused to rotate in the direction indicated by arrow **3**. Upon rotation of the second shaft **56**, the second gear **54** in the second transition box 22_B will also be caused to rotate in the direction indicated by arrow **3**, i.e., in the same direction as the first gear **50** in the first transition box 22_A. However, rotation of the second gear **54** (FIG. **5**) will cause rotation of the first gear **50**, and consequently, the first shaft **52**, in the opposite direction, i.e., in the direction indicated by arrow **4**, due to the mating engagement of the gears **50**, **54** via the teeth **58**, **60** (FIG. **5**). The transmission rod **48** of the second transition box 22_B will also be caused to rotate in the direction indicated by arrow **4** due to the mechanical connection of the transmission rod **48** to the first shaft **52**.

Given the connection between the transmission rod **48** and the output assembly 112_B (FIG. **12**) of the height adjustment mechanism 104_B, the output assembly 112_B, will be caused to rotate in the direction indicated by arrow **4**. Consequently, due to the connection between the output assembly 112_B and the drive screw 106_B via the gear assembly 104_B (FIGS. **1**, **12**), the drive screw 106_B will be caused to rotate in the direction indicated by arrow B (FIG. **12**). As shown in FIG. **12**, the respective directions of rotation A, B of the drive screws 106_A, 106_B are opposite each other. As such, the height of the end board 14_B (FIGS. **1**, **2**), and consequently, the height of the second end **20** (FIG. **2**) of the frame **16**, will be raised, thereby resulting in uniform adjustment in the height of the frame **16** along the length "L" (FIG. **2**).

Referring now to FIGS. **13** and **14**, in another aspect of the present disclosure, the frame assembly **12** discussed above in connection with FIGS. **1-12**, may be used in connection with a pair of end boards identified by the reference character **120**, only one of which is shown. Each end board **120** is characterized as either a "headboard" or a "footboard" based upon its positioning relative to the frame **16**.

In contrast to the end boards **14**$_A$, **14**$_B$ discussed above with respect to FIGS. **1**, **2**, and **10**, for example, each end board **120** is identical in structure and operation. As such, the end boards **120** are interchangeable with one another. One example of such an end board is described in U.S. Pat. No. 6,983,495 ("the '495 patent"), for example. Although specific details regarding the structure and functionality of each end board **120** can be ascertained through reference to the '495 patent, the end boards **120** will be discussed briefly herein below.

Each end board **120** includes a pair of legs **122** that are connected by an upper cross member **124** and a lower cross member **126**. The legs **122** each include an internal hollow portion (not shown) that is configured and dimensioned to receive an inner member **128** such that the legs **122** are vertically movable relative to the inner members **128**.

Each end board **120** further includes a height adjustment mechanism **132** that facilitates movement of the legs **122** relative to the inner members **128** to allow for variations in the height of the end board **120**. The height adjustment mechanism **132** includes a gearbox **134**, and a drive screw **136** that is secured to the respective upper and lower cross members **124**, **126**. The drive screw **136** is connected to the gearbox **134** such that actuation of the gearbox **134** causes rotation of the drive screw **136** to adjust the height of the end board **120**.

One gearbox **134** is fixed to each end board **120**. Each gearbox **134** includes a housing **138** that accommodates an upper shaft **140** and an upper gear assembly **142**, as well as a lower shaft **144** and a lower gear assembly **146**. The upper and lower gear assemblies **142**, **146** respectively include a plurality of teeth **148**, **150**, which cause meshing engagement of the upper and lower gear assemblies **142**, **146** such that rotation of the upper gear assembly **142** in one direction causes simultaneous rotation of the lower gear assembly **146** in the opposite direction.

As can be appreciated through reference to FIGS. **13** and **14**, given the vertical orientation of the respective upper and lower gear assemblies **142**, **146**, the distance between the upper gear assembly **142** and the frame **16** (FIGS. **1**, **2**) will be different than the distance between the lower gear assembly **146** and the frame **16**.

During use, a drive shaft, such as the aforedescribed drive shaft **26** seen in FIGS. **1** and **2**, for example, extends between the gearboxes **134** included on the end boards **120**. Specifically, the first end **68** (FIG. **2**) of the drive shaft **26** engages the upper shaft **140** (FIG. **14**) of one gear box, i.e., the gearbox **134** included on the headboard, and the second end **70** (FIG. **2**) of the drive shaft **26** engages the lower shaft **144** (FIG. **14**) of the other gear box, i.e., the gear box **134** included on the footboard.

Upon actuation of the headboard gearbox **134**, for example, the upper shaft **140** and the upper gear assembly **142** rotate in a first direction, which causes corresponding rotation of the drive shaft **26** (FIG. **2**), as well as the headboard drive screw **136** (FIG. **13**), to thereby adjust the height of the headboard.

Rotation of the drive shaft **26** (FIG. **2**) causes simultaneous actuation of the gearbox **134** included on the footboard. Specifically, the drive shaft **26** causes the lower shaft **144** (FIG. **14**) and the lower gear assembly **146** to rotate, also in the first direction. However, due to the meshing engagement of the lower gear assembly **146** with the upper gear assembly **142**, the upper gear assembly **142** is caused to rotate in a second direction opposite to the first direction. Rotation of the upper gear assembly **142** in the second direction causes corresponding rotation of the footboard drive screw **136** to thereby adjust the height of the footboard.

Since the upper gear assemblies **142**, **146** of the gearboxes **134** included on the headboard and the footboard are caused to rotate in opposite directions, the drives screws **136** (FIG. **13**) respectively included on the headboard and footboard will also rotate in opposite directions, thereby causing uniform adjustment in the height of the headboard and the footboard.

With reference now to FIGS. **1-5**, **13**, and **14**, the use and operation of the presently disclosed frame assembly **12** (FIGS. **1**, **2**) will be discussed in connection with identical end boards, e.g., a headboard and a footboard similar to the end board **120** (FIG. **13**) described above, and disclosed in the '495 patent.

Initially, the first end **18** (FIG. **2**) of the frame **16** is secured to a first end board **120** (FIG. **13**), e.g., a footboard, and the second end **20** (FIG. **2**) of the frame **16** is secured to a second end board **120** (FIG. **13**), e.g., a headboard, such that the gearboxes **134** face each other. Thereafter, the transition box **22**$_A$ (FIGS. **1**, **2**) is connected to the height adjustment mechanism **132** (FIG. **13**) on the footboard, and the transition box **22**$_B$ (FIGS. **1**, **2**) is connected to the height adjustment mechanism **132** (FIG. **13**) on the headboard. Specifically, the transmission rod **48** (FIGS. **2-4**) of the transition box **22**$_A$ is secured to the gear box **134** (FIG. **13**) on the footboard, and the transmission rod **48** (FIGS. **2**, **5**) of the transition box **22**$_B$ is secured to gear box **134** on the headboard.

The shaft **140**, **142** (FIG. **14**) to which the transmission rod **48** (FIGS. **2-4**) of the transition box **22**$_A$ is secured will determine which shaft **140**, **142** is connected to the transmission rod **48** of the transition box **22**$_B$. For example, if the transmission rod **48** of the transition box **22**$_A$ is secured to the upper shaft **140** of the footboard gearbox **134**, then the transmission rod **48** of the transition box **22**$_B$ will be secured to the lower shaft **144** of the headboard gearbox **134**, whereas securing the transmission rod **48** of the transition box **22**$_A$ to the lower shaft **144** of the footboard gearbox **134** will require securement of the transmission rod **48** of the transition box **22**$_B$ to the upper shaft **140** of the headboard gearbox **134**.

Either prior, or subsequent, to respective connection of the transition boxes **22**$_A$, **22**$_B$ (FIGS. **1**, **2**) with the gearboxes **134** (FIGS. **13**, **14**) included on the end boards **120**, the drive shaft **26** is connected to the transition boxes **22**$_A$, **22**$_B$ in the manner discussed above.

Following connection of the drive shaft **26** to the transition boxes **22**$_A$, **22**$_B$, a rotational force is applied to one of the gearboxes **134** (FIGS. **13**, **14**) included on the end boards **120**, either manually, or via motorized actuation.

Upon actuation of one of the gearboxes **134**, e.g., the gearbox **134** included on the footboard, a rotational force will be transmitted to the footboard drive screw **136** to thereby adjust the height of the footboard. Concomitantly, the transmission rod **48** (FIGS. **2-4**) of the transition box **22**$_A$, which is connected to the gear box **134**, will be caused to rotate in a first direction due to the connection between the transmission rod **48** and the upper shaft **140** (FIG. **14**) in the present example.

Rotation of the transmission rod **48** (FIGS. **2-4**) of the transition box **22**$_A$ in the first direction will cause rotation of the transmission rod **48** (FIGS. **2**, **5**) of the transition box **22**$_B$ in the same direction via the series of mechanical connections discussed above with respect to FIGS. **1-12**, e.g., via connection of the transition boxes **22**$_A$, **22**$_B$ to the drive shaft **26** (FIGS. **1**, **2**). Concomitantly with rotation of the transmission rod **48** (FIGS. **2**, **5**) of the transition box **22**$_B$, the lower shaft **144** (FIG. **14**) of the gearbox **134**, to which the drive shaft **26** (FIGS. **1**, **2**) is connected in the present example, will also be caused to rotate in the first direction. Due to the meshing engagement of the respective upper and lower gear assemblies **142**, **146** (FIG. **14**), the upper gear assembly **142** of the headboard gearbox **134** will be rotated in a second direction opposite the first direction, which will thereby cause corresponding rotation of the headboard drive screw **136** (FIG. **13**) in the direction opposite that of the footboard drive screw **136** to adjust the heights of the end boards **14** uniformly, as previously described.

As mentioned above, it is contemplated herein that the length "L_R" (FIG. **4**) of the transmission rods **48** included on the transition boxes **22**$_A$, **22**$_B$ (FIGS. **1**, **2**) may be adjusted, e.g., during assembly of the bed system **10**. The adjustable length "L_R" (FIG. **4**) of the transmission rods **48** renders the presently disclosed frame assembly **12** (FIGS. **1**, **2**) compatible with a variety of end boards, e.g., the dissimilar end boards **14**$_A$, **14**$_B$ discussed above with respect to FIGS. **1**, **2**, and **10**, or the identical end boards **120** discussed above with respect to FIGS. **13** and **14**, by relaxing design tolerances, and allowing for adjustments to compensate for dimensional inconsistencies.

Additionally, the compatibility of the presently disclosed frame assembly **12** (FIGS. **1**, **2**) with various end boards is increased by the aforedescribed adjustability in the length "Ls" (FIG. **2**) of the drive shaft **26**, which further relaxes design tolerances, and allows for additional adjustments to compensate for dimensional inconsistencies.

Turning now to FIGS. **15-19**, another embodiment of an adjustable bed system provided in accordance with the present disclosure is shown generally identified by reference numeral **200**. Bed system **200** is similar to bed system **10**, described above, and, thus, only the differences therebetween will be described in detail, while similar aspects between bed systems **10**, **200** will be either summarily described or omitted entirely to avoid unnecessary repetition. Further, although bed systems **10**, **200** are shown including various different features, it is envisioned that the various different features of bed systems **10**, **200** may be interchangeable with one another. In other words, any or all of the features discussed herein with respect to bed systems **10**, **200** may also be used in conjunction with the other bed system **10**, **200** to the extent that they are consistent with one another.

As shown in FIG. **15**, bed system **200** includes a frame assembly **212**, and a pair of end boards **14**$_A$, **14**$_B$ that are secured to opposite ends of the frame assembly **212**. The frame assembly **212** includes a frame **216** with respective first and second ends **218**, **220**, respectively. A transition box **222** is coupled to one of the first and second ends, e.g., first end **218**. A drive shaft **26** is removably disposed between first and second ends **218**, **220**, respectively. A bracket member **220** extends downwardly from frame **216** to support drive shaft **26** extending therealong. The first end **218** of the frame **216** is secured to the end board **14**$_A$, and the second end **220** of the frame **216** is secured to the end board **14**$_B$. Frame **216** may further include a metallic mesh **300** disposed thereon, as will be described below with reference to FIGS. **17-18**. End boards **14**$_A$, **14**$_B$, or any other suitable end board may be configured for use with bed system **200**. End boards **14**$_A$, **14**$_B$ are described in detail above and, thus, will not be described hereinbelow.

With reference now to FIGS. **15-16**, transition box **222** will be described. The transition box **222** includes a mounting structure **236** that facilitates connection of the transition box **222** to the frame **216** adjacent the first end **218** thereof. Mounting structure **236** extends downwardly from frame **216** (although outer configurations are contemplated) to engage housing **240** of transition box **222**. Housing **240** accommodates the internal components of transition box **222** and includes a first end **242** with an internal gear assembly **244**, and a second end **246** with a transmission rod **248** that extends outwardly therefrom.

The internal gear assembly **244** includes first and second gears **250**, **254**, respectively, that are operably engaged to one another, i.e., wherein the teeth of the first and second gears **250**, **254** are disposed in meshed, or mating relation with one another, in vertical registration relative to one another, as best shown in FIG. **16**. First gear **250** is fixedly supported on a first shaft **252**, which extends towards first end **242** of housing **240**. First shaft **252** is also fixedly secured to, or monolithically formed with, transmission rod **248** in coaxial alignment therewith. As mentioned above, transmission rod **248** extends from second end **246** of housing **240**. Second gear **254** is supported on a second shaft **256** that is offset relative to first shaft **252** and, thus, transmission rod **248**. Second shaft **256**, similar to first shaft **252**, extends towards first end **242** of housing **240**. As can be appreciated, rotation of first shaft **252** in a first direction rotates transmission rod **248** in a similar direction. On the other hand, rotation of second shaft **256** in the first direction rotates second gear **254** in that first direction, thereby rotating first gear **250** and, thus, transmission rod **248** in an opposite direction. Markings U and L (marking the upper, or first gear **250** and the lower, or second gear **254**, respectively) may be provided on the outer surface of housing **240** to help distinguish between first and second gears **250**, **254**, respectively, and the corresponding modes of operation thereof, which will be described hereinbelow.

With continued reference to FIGS. **15-16**, drive shaft **26** includes a first end **68** that is configured and dimensioned for selective engagement with the transition box **222**, and a second end **70** that is configured and dimensioned for selective engagement directly to end board **14**$_B$. More specifically, first end **68** of drive shaft **26** include structure that is configured and dimensioned for releasable and selective connection to both first and second shafts **252**, **256** of the internal gear assembly **244** positioned within housing **240** of transition boxes **222**. Second end **68** may include similar structure to releasably connect to end board **14**$_B$.

Referring now to FIGS. **17-18**, as mentioned above, bed frame **216** may include a resilient metallic mesh **300** disposed thereon that is configured to resiliently support the mattress (not shown) thereon. Mesh **300** includes a plurality of longitudinal wires **310** and a plurality of lateral wires **320** that are inter-woven with one another to form mesh **300**. A coil spring **330** is disposed at either or both ends of each of wires **310**, **320** to resiliently secure mesh **300** about frame **216**. More particularly, frame **216** includes a plurality of apertures define through an outer periphery thereof for securing coil springs **330** thereto. As best shown in FIG. **18**, coil springs **330** may be color-coded, or otherwise distinguished to facilitate assembly and/or use of bed system **200**. For example, coil springs **331**, **333** and **334** may be uncolored, e.g., silver, while coil spring **332** is painted a different color that is easily distinguishable from silver, e.g., black or red. Such a feature may be used to indicate where to attach side rails (not shown) or other structure to frame **216**. Further, markings, stickers, or other identification members may be used to further identify attachment positions for engagement of various different components to frame **216**.

FIG. **19** shows another embodiment of a bracket member **220** secured to the frame **216**. Bracket member **220** generally defines a rectangular-shaped plate **221** having first and second triangular-shaped wings **284**, **286** extending outwardly therefrom for securely engaging bracket member **220** to frame **216**, e.g., via welding. Bracket member **220** further includes a longitudinally-oriented opening **288** defined through plate **221** that is configured and dimensioned to allow the drive shaft **26** to pass therethrough.

With continued reference to FIG. **19**, a ring member **228** is configured and dimensioned for positioning adjacent bracket member **220**. Ring member **228** includes an opening **292** extending therethrough that is configured and dimensioned to receive the drive shaft **26** and a screw member **230** that can be brought into and out of engagement with the drive shaft **26** to fix the position of the drive shaft **26** relative to the ring member **228**. Ring member **228** defines an outer dimension that is larger than the dimension of the opening **288** extending through plate **221** of bracket member **220** and is configured for positioning closer to transition box **222** (FIG. **15**) relative to bracket member **220**. This configuration helps retain drive shaft **26** in engagement with transition box **222** (FIG. **15**), especially in embodiments where drive shaft **26** is spring-biased toward a more-extended position. In such an embodiment, the ring member **228** inhibits further extension of drive shaft **26** due to positioning of ring member **228** relative to bracket member **220**, thus retaining drive shaft **26** in engagement with transition box **222** (FIG. **15**). Further, wings **284**, **286** inhibit substantial lateral movement of ring member **228** disposed therebetween, thus providing additional lateral support for drive shaft **26**.

Referring to FIGS. **15-16**, the assembly, use, and operation of bed system **200** will be briefly described to further point out the differences between bed system **10** and bed system **200**. Similarly as described above with respect to bed system **10**, bed system **200** may be configured for use with identical end boards, e.g., a pair of end boards **120** (FIG. **13**), or with different end boards $\mathbf{14}_A$, $\mathbf{14}_B$. For brevity purposes, the assembly, use, and operation of bed system **200** will be described mainly with respect to end boards $\mathbf{14}_A$, $\mathbf{14}_B$, although the differences associated with the use of end boards **120** will be pointed out as well.

Initially, the end boards are positioned as illustrated in FIG. **15** such that the output assembly $\mathbf{112}_A$ of the height adjustment mechanism $\mathbf{104}_A$ included on the end board $\mathbf{14}_A$ faces the output assembly $\mathbf{112}_B$ (FIGS. **1**, **2**, **12**) of the height adjustment mechanism $\mathbf{104}_B$ included on the end board $\mathbf{14}_B$. Thereafter, the frame **216** is secured to the end boards $\mathbf{14}_A$, $\mathbf{14}_B$, and the transmission rod **248** of the transition box **222** is connected to the output assembly $\mathbf{112}_A$. Either prior, or subsequent, to connection of the end boards $\mathbf{14}_A$, $\mathbf{14}_B$, the drive shaft **26** is connected to transition box **222** at one end thereof and directly to the output assembly $\mathbf{112}_B$ of end board $\mathbf{14}_B$ at the other end thereof.

More specifically, the drive shaft **26** is connected to one of first and second gears **250**, **254**, respectively, depending on the configuration of the end boards used. For example, where end boards $\mathbf{14}_A$, $\mathbf{14}_B$ are used, drive shaft **26** is connected to second gear **254** such that rotation of transmission rod **248** of transition box **222** effects opposite rotation of drive shaft **26**. On the other hand, where end boards **120** are used, drive shaft is connected to first gear **250** such that rotation of transmission rod **248** effects rotation of drive shaft **26** is a similar direction.

Following connection of the drive shaft **26**, hand crank **116** is coupled to height adjustment mechanism $\mathbf{104}_A$ of end boars $\mathbf{14}_A$ such that, upon rotation of the hand crank **116**, the height of the end board $\mathbf{14}_A$ will be adjusted. More specifically, upon rotation of the hand crank **116** in a first direction, the height of the end board $\mathbf{14}_A$ will be increased. Concomitantly, with rotation of the hand crank **116**, the transmission rod **248** of the transition box **222** is caused to rotate in a similar direction. Rotation of the transmission rod **248** effectuates corresponding rotation of first shaft **252** and first gear **250** which, in turn, causes rotation of second gear **254** in the opposite direction. Accordingly, with second gear **254** rotating in the opposite direction, drive shaft **26**, which is coupled thereto, is similarly rotated in the opposite direction relative to transmission rod **248**. The opposite rotation of transmission rod **248** and drive shaft **26** effects similar raising or lowering of end boards $\mathbf{14}_A$, $\mathbf{14}_B$ relative to frame **216**, depending on the direction of rotation of hand crank **116**.

On the other hand, as mentioned above, where end boards **120** are used, drive shaft **26** is connected to first gear **250** such that rotation of transmission rod **248** effects rotation of drive shaft **26** is a similar direction, thereby effecting similar raising or lowering of end boards **120** relative to frame **216**, depending on the direction of rotation of hand crank **116**.

The above description, disclosure, and figures should not be construed as limiting, but merely as exemplary of particular embodiments. It is to be understood, therefore, that the disclosure is not limited to the precise embodiments described, and that various other changes and modifications may be effected by one skilled in the art without departing from the scope or spirit of the present disclosure. Additionally, persons skilled in the art will appreciate that the features illustrated or described in connection with one embodiment may be combined with those of another, and that such modifications and variations are also intended to be included within the scope of the present disclosure. Therefore, the above description should not be construed as limiting, but merely as exemplifications of particular embodiments.

What is claimed is:

1. An adjustable bed system comprising:

first and second end boards each having an independent height adjustment mechanism therein;

a frame assembly configured and dimensioned to be secured to the first end board at a first end thereof and to the second end board at a second end thereof, the frame assembly including:

a frame; and

a transition box secured to the frame at the first end thereof, the transition box operatively engagable with the height adjustment mechanism of the first end board; and

a drive shaft adjustable between a first length and a second length, the drive shaft coupled at a first end thereof to the transition box and coupled at a second end thereof to the second end board, the drive shaft operable to facilitate uniform height adjustment of the first and second end boards,

wherein the transition box includes a housing having first and second inputs at one end thereof, each input having a gear selectively couplable to the first end of the drive shaft, the gears disposed in meshed engagement with one another, the transition box further including a rod extending outwardly from the other end thereof, the rod coupled to the gear of the first input and engaged to the height adjustment mechanism of the first end board.

2. The bed system of claim **1**, wherein the drive shaft includes a center portion, and a plurality of outer portions extending from the center portion, the center portion and the outer portions being connected in telescoping arrangement to facilitate selective adjustment of the drive shaft between the first and second lengths.

3. The bed system of claim **1**, wherein the transition box includes markings on an outer periphery of the housing and adjacent to at least one of the first and second inputs to distinguish the first and second inputs from one another.

4. The bed system of claim 1, wherein the gears of the first and second inputs are disposed in vertical registration relative to one another.

5. The bed system of claim 1, wherein the first and second end boards are identical in structure.

6. The bed system of claim 5, wherein the drive shaft is coupled to the gear of the second input of the transition box such that the rod and the drive shaft are rotatable in opposite directions to effect uniform height adjustment of the first and second end boards.

7. The bed system of claim 1, wherein the first end board is different from the second end board.

8. The bed system of claim 7, wherein the drive shaft is coupled to the gear of the first input of the transition box such that the rod and the drive shaft are rotatable in similar directions to effect uniform height adjustment of the first and second end boards.

9. The bed system of claim 1, wherein the length of the drive shaft is adjusted to accommodate usage of various different end boards with the frame assembly.

10. The bed system of claim 1, wherein the length of the drive shaft is adjusted to accommodate engaging the drive shaft within a plurality of inputs of the transition box.

11. The bed system of claim 1, further comprising a bracket member engaged to the frame and extending from an underside thereof, the bracket member configured and dimensioned to receive the drive shaft at least partially therethrough to inhibit relative movement between the drive shaft and the frame.

12. The bed system of claim 1, wherein at least one component of the frame assembly is color-coded to identify an attachment position on the frame.

13. A frame assembly for use in an adjustable bed system including a first end board with a first height adjustment mechanism therein, and a second end board with a second height adjustment mechanism therein, the frame assembly comprising:

a frame;

a drive shaft extending along a length of the frame and coupled to the height adjustment mechanisms of the first and second end boards, the drive shaft operable to facilitate uniform height adjustment of the first and second end boards; and

a bracket member engaged to the frame on an underside thereof, the bracket member including a first end with a first side opening defining an inner dimension, and a second end with a second side opening defining an inner dimension, the first and second side openings configured and dimensioned to receive the drive shaft therethrough and inhibit relative movement between the drive shaft and the frame.

14. The bed system of claim 13, wherein the frame assembly further includes a ring member including an opening extending therethrough configured and dimensioned to receive the drive shaft, the ring member defining an outer dimension larger than the inner dimensions of the first and second side openings of the bracket member, whereby the ring member is prevented from passing through the first and second side openings in the bracket member to further inhibit relative movement between the drive shaft and the frame.

15. The bed system of claim 14, wherein the ring member further includes a screw member that is repositionable relative to the ring member to vary the opening extending through the ring member, to thereby selectively inhibit relative movement between the drive shaft and the ring member.

16. The bed system of claim 13, wherein the bracket member includes a plate having a pair of wings extending therefrom for engaging the bracket member to the frame, the plate including an opening defined therethrough that is configured and dimensioned to permit passage of the drive shaft therethrough.

17. The bed system of claim 13, wherein the drive shaft defines an adjustable length, the drive shaft selectively adjustable between a first length and a second length for at least one of coupling to various different types of end boards and coupling to the first and second end boards in different positions.

18. The bed system of claim 13, wherein at least one component of the frame assembly is color-coded to identify an attachment position on the frame.

* * * * *